FRIDAY, JUNE 8, 1883.

AN ILLUSTRATION OF AN ABUSE.

AFTER having taken special care in the selection of daily papers for quiet reading, it is disheartening to find one of the most conservative and elevated of these making use of methods which are suggestive of the broad prairie and the backwoods. It appears, however, from a recent example, that we cannot feel quite safe in taking up even the dignified *New York evening post*. In the issue of that paper of May 15, there is a notice headed, '*A Thrilling Government Report.*' A careful examination of the matter shows that the sole object of the heading and the notice is to ridicule the report, or, at least, to create merriment at its expense. This is a mode of procedure against which the present writer has already protested in an article entitled 'Science and the newspapers,' and it seems desirable to again call attention to the true nature of the crime against science which is here involved.

The objectionable notice begins thus: "The United States geological survey has just issued its 'Bulletin No. 1,' on the popular subject, 'On hypersthene-andesite, and on triclinic pyroxene in augitic rocks.' These are the conclusions reached: 1. 'An apparently typical augite-andesite from the Buffalo Peaks is found to contain *hypersthene* as its chief pyroxenic constituent,'" etc. Other conclusions drawn by the author, and, of course, expressed in technical language, are then quoted, and nothing further is said. The wit, it will be seen, is very simple, depending upon the heading above quoted, and the introduction of the word 'popular' in the introductory sentence. To one who is constantly dealing with scientific matters, or to one who is tolerably familiar with such matters, even though he may have a keen sense of humor, there is nothing particularly funny in this. But probably it does appear funny to those who are totally ignorant of science. Big words are apt to seem funny to those who do not understand them. One has not far to go for fun of that kind. Almost any paper on a special subject will furnish it. A mathematical paper, for example, is richer in material for it than any other. It must be acknowledged, however, that, if the simple quoting of the language of a technical paper is wit, that wit must be of a very low order.

Leaving entirely out of consideration the character of the wit, the questions suggest themselves whether the display of such wit is worth while, and whether the harm done by it does not greatly over-balance the little good that comes from it in the shape of fun.

What we need as much as any thing else in this country, is an increased appreciation of the real value of scientific work. The 'we' is used in the broadest sense. We as a nation need it, and the influence of those in high places should be exerted in such a way as to develop this appreciation. The average man has somehow got the idea that pure science is of no value, and that there is something absurd about the efforts of quiet investigators who spend their lives in dealing with matters which are of no 'practical' importance. This is a state of mind which is very common, and it needs treatment. Now, the proper way to treat it is not to encourage it, but to point out, over and over again, its error. Ridiculing scientific papers tends to encourage the average man in his false notions, and to perpetuate his benighted condition.

The subject is one of more importance than may appear at first sight. Progress in the greatest things is dependent upon attention to the smallest things. If it is desired to improve the state of the public mind in regard to scientific matters, the greatest care should be used in presenting these matters. Above all, let us be extremely cautious about sacrificing science for the sake of humor. We, as a people, are especially susceptible to the influence of humor. It has been said with considerable truth, that there is nothing about which an American will not joke. Every one has known cases in which this tendency to joking has led to a pretty definite form of insanity, than which there is nothing more hopeless. Now,

when the results of scientific investigations are used as a medium for humor, their true objects are, of course, entirely lost sight of, and science is belittled; and, as humor appeals to the greater number the lower its order, it is clear that the kind of humor we are dealing with must appeal to large numbers of those who are in special need of enlightenment.

Scientific investigations are not proper subjects for the display of wit. The object of these investigations is to discover the foundation of all things, — the truth. Let a man once grasp that idea, let him become imbued with it, let him go through the process of intellectual regeneration necessary to enable him fully to appreciate it, and it will henceforth be impossible for him to touch upon the subject of investigation without experiencing feelings which are totally incompatible with ordinary wit. This is the right attitude towards scientific matters. It cannot be brought about all at once, but the day when it shall be the general attitude can be hastened by those who mould public opinion.

Gentlemen of the press, it is your duty to do all in your power to encourage scientific work, and to give the people right ideas concerning it. We cannot expect this from all. There are many among you whose highest ambition it is to secure and construct 'readable' articles at any sacrifice of principle. But surely it is not too much to expect of those who evidently recognize the importance of higher things.

THE DRY- AND WET-BULB HYGROMETER.[1]

It is not my purpose at present to discuss the theories which underlie hygrometric observations, but rather to ascertain if it is possible to obtain uniform and trustworthy results from the simple observation of this instrument. There has been much discussion of late upon this subject, and grave doubts are continually being thrown upon its accuracy.

It is proposed to ascertain, first, the best method of conducting observations, and, second, the accuracy of the results when compared with a fixed standard. The following is a brief statement of the principles upon which the action of this instrument is based: —

"The evaporation of a liquid involves the conversion of sensible into latent heat; and the supply of heat must be drawn from the liquid or from surrounding objects. At some point the amounts of heat subtracted and communicated will be equal, and an invariable temperature of evaporation will result, depending upon the amount of moisture present."

From this invariable temperature we may be able, by suitable formulae, to obtain the hygrometric state of the atmosphere.

It would seem as though a thermometer-bulb, from which moisture is continuously evaporated, ought to give this needed temperature; yet every one who has had occasion to make such observations has encountered great difficulties, and has become satisfied, that as commonly made, though the readings are of the simplest character, yet the results are frequently entirely inaccurate. This is partially shown by an examination of the various directions that have been published from time to time. Regnault, writing in 1845, says, "I prefer thermometers with cylindrical bulbs as more susceptible to the variations of temperature, and because, for the same mass of mercury, they present a much greater surface to the air. The manner of moistening, I find, makes no difference so long as there is an abundance of liquid. If a drop falls from time to time from the extremity of the bulb, I have still observed no sensible difference. The longer or shorter course which the water runs on the cotton wick exercised no perceptible influence." Other authorities may be quoted as follows: —

Bulbs of both thermometers should project an inch and a half to two inches below the scales; and all objects, metallic or otherwise, which can affect the temperature, should be removed.[1]

All authorities mention the necessity of using rain or distilled water, of frequent cleansing of the muslin, and of changing it at intervals of from half a month to three months. The greatest difference of opinion, however, is in relation to observations below freezing, 'under which circumstances,' says Mr. Scott in his

[1] Read before the Philosophical society of Washington, D.C., May 5, 1883, at its 235th meeting.

[1] This is an important matter. I have seen several illustrations of this instrument, showing the scales extending below the thermometer-bulb; and many otherwise accurate thermometers are made with a metallic scale prolonged so as to afford protection to the bulb. In using such a thermometer as a wet bulb, I have found, with the scale, a mean temperature 1.2° higher than without it; the air was still; there was an abundance of moisture, and over 10° difference between the dry and the wet. This is due partly to the heat radiated from so near an approach of metal at least 10° hotter than the wet bulb, and partly to the arrest of evaporation by the scale.

book just issued, 'the dry- and wet-bulb hygrometer fails.' Some of the directions are as follows: —

Wet the muslin with a camel's-hair brush or a sponge fifteen minutes before the observation. The film of ice should be as thin as possible. Remove the muslin, and wet with brush. Wet, by raising a cup and immersing the bulb for a moment, twenty minutes before the reading. Wet some time, say an hour, before the observation. Wet immediately after a reading, and it will be ready for the next. One authority suggests, that, if the air is still, it is well to increase the evaporation by a fan. Regnault has established that no appreciable error is introduced by an air-current as high as five or six metres per second (metres per second may be readily converted into miles per hour by using the factor 2.24). The Italian government, some years ago, introduced an induced air-current in their hygrometric observations.

Relative humidity at 7 A.M., February, 1883.

Deduced from observations of the dry- and wet-bulb hygrometer

	(1) Kendall Green.	(2) Fort Myer.	(3) West Washington.	(4) Naval Observatory.	Residuals. (1)−(2)	(1)−(3)	(1)−(4)
Feb. 1	76	77	76	100	− 1	0	−24
" 2	75	88	80	100	−13	− 5	−25
" 3	87	89	89	91	− 2	− 2	− 4
" 4	88	78	86	96	10	2	− 8
" 5	95	100	94	94	− 5	1	1
" 6	72	61	80	88	11	− 8	−16
" 7	98	100	89	100	− 2	9	− 2
" 8	83	68	76	94	15	7	−11
" 9	88	77	88	93	11	0	− 5
" 10	75	64	70	82	11	5	− 7
" 11	80	100	83	100	−20	− 3	−20
" 12	64	72	53	73	− 8	11	− 9
" 13	88	88	82	82	0	6	6
" 14	85	100	88	94	−15	− 3	− 9
" 15	100	100	89	96	0	11	4
" 16	98	100	100	100	− 2	− 2	− 2
" 17	90	100	100	100	−10	−10	−10
" 18	84	100	100	87	−16	−16	− 3
" 19	80	73	73	94	7	7	−14
" 20	84	83	82	100	1	2	−16
" 21	74	53	62	61	21	12	13
" 22	87	77	78	88	10	9	− 1
" 23	76	60	72	89	16	4	−13
" 24	83	73	69	94	10	14	−11
" 25	78	79	100	100	− 1	−22	−22
" 26	80	60	73	68	20	7	12
" 27	84	70	52	87	14	32	− 3
" 28	81	79	68	100	2	13	−19
Mean for Feb.	83	81	80	91	2	3	− 8
		Iowa Circle					
" " March	64	72	68	85	− 7	− 4	−21

As an illustration of the varying results obtained by the common method of observing this hygrometer, I have given the preceding table, showing the relative humidity at four stations in Washington. 1. Kendall Green. This station is situated about a mile and a half north-east of the capitol, and has an exposure of thermometers some fifty feet above ground. 2. Fort Myer, situated about three miles west, and has an exposure about forty feet above ground. 3. West Washington, situated about three miles west, with an exposure about thirty feet above ground. 4. Naval observatory, about two miles west, with an exposure four feet above ground.

This table shows an extreme difference of 35% for a single observation. The very high per cent found at the observatory is due in part to the exposure being so near the ground. This suggests an interesting subject for investigation. It has been determined by experiment in Europe, that, with proper precautions, the actual air-temperature is the same, whether measured at five or a hundred feet above ground. Now, if it be found that the lower exposure gives higher percentage of moisture, due to the settling of fog-banks or strata of damp air, it becomes a matter of the highest importance to ascertain the differences in moisture in different strata, and to settle upon some uniform height for all hygrometric observations.

During the past winter, I have made a large number of readings, hoping to remove some of the recognized difficulties in this class of observations. The exposure of the hygrometers was from a north window forty feet above ground. Great care was taken to exclude all heated currents. The temperatures were from 10° to 50° F.

As an example of these observations, I append a table exhibiting two sets of readings taken on Feb. 13, 1883. The air was perfectly still, and the pressure was 30.40″. The readings were made at intervals, as shown in the table, without disturbing the instrument.

Readings of dry- and wet-bulb hygrometer on Feb. 13, 1883.

First set.			Second set.		
Time.	Temperature.		Time.	Temperature.	
	Dry.	Wet.		Dry.	Wet.
4.29 A.M.	-	Wetted.	5.37 A.M.	-	Wetted.
4.37 "	31.8°	32.1°	5.47 "	31.5°	32.1°
4.50 "	31.3	31.4	6.4 "	31.8	32.0
5.4 "	31.1	30.3	6.17 "	30.9	30.9
5.14 "	31.0	30.0	6.28 "	31.0	30.4
5.19 "	31.0	29.8	6.36 "	30.9	30.1
5.26 "	31.1	29.4	6.54 "	30.6	28.4
5.29 "	31.0	29.1	7.0 "	31.0	29.4
5.32 "	31.0	29.4			

As the temperature of the wet bulb was rising at the last observation in each case, it is

evident that the ice had entirely evaporated. At the 5.29 reading, Regnault's formula gives a dew-point of 25 3°, and the condensing hygrometer gave at the same time a dew-point 20.4°. In the second set at 6.54, *seventy-seven minutes after wetting*, the dew-points were 24.0° and 19.7° respectively. It will be seen that the length of time required in the last set (seventy-seven minutes) is entirely too great for good results, as in this time the temperature may change several degrees; and there is so great uncertainty in the length of time required, that, to obtain a good result, it would be essential to wet the bulb an hour and a quarter or an hour and a half before the time, and then note the temperature from time to time in order to catch it when it has ceased falling. The above conditions of observation are ordinarily impracticable, and, besides, the final results, showing dew-points about 4.5° higher than the condensing hygrometer, are entirely unsatisfactory.

I have investigated the effect of an induced air-current as a means of effectually removing these and other objections. Experiments were tried with fans, common hand-bellows, and a Casella whirling apparatus. All of these trials showed, that, with a velocity of the air-current ranging from 1.5 to 5 metres per second, the readings of the dry- and wet-bulb hygrometer are nearly identical.

The length of time required to bring down the wet-bulb temperature rarely exceeds two minutes: in only one extreme case did it require thirteen minutes. If it be objected that any form of motor for producing an air-current must necessarily compress the air, and by heating it vitiate the results, it may be said that the compression need be very slight. Experiment shows that the induced current produces, if any thing, a lower temperature, at least in the winter season; and, since the air-current reaches both thermometers, the differential results will not be affected.

The most satisfactory showing of experiments with an induced air-current, however, is that uniform and accurate results may always be obtained at temperatures as low as 10° (which is the limit that has occurred the past winter), as determined by comparison with a Regnault's condensing hygrometer; and undoubtedly the same would be found at temperatures even below 0° F. The simplest motor for the induced current for any exposure, except from a window, is a common fan; another convenient form, and one by far the easier to use, is the hand-bellows. For a window-shelter, the latter can be readily rigged with a pulley and string so as to be operated from within; and this is the form used by myself. I have mentioned above the whirling apparatus of Casella. This, though giving good results, is much more complicated and expensive, and is, moreover, unsuited to a window-shelter. There are manifold other forms of motors, but it is doubtful if they would be any better than those already described.

I have carefully measured the induced air-currents with a Casella air-meter, and have found that a fan making a hundred strokes a minute in one direction, and placed within three or four inches of the meter, gives a velocity of 1.5 metres per second; that a bellows of a litre capacity, making fifty strokes to the minute, at a distance of six inches, gave a velocity of 2 metres per second, while at twelve inches it gave 1.8 metres per second; and that the whirling apparatus easily revolved the thermometers at the rate of 5 metres per second.

The expense of a fan would be nominal; a strong hand-bellows, with all necessary appliances, ought not to cost more than $2.50.

In order to exhibit the advantage to be gained by ventilating this hygrometer, I give the following table, containing observations with it, and, for comparison, those with the condensing hygrometer, as made at seven A.M. during twenty-nine days of March, 1883.

From this table we see that columns 6 and 7, which contain dew-points computed from the ventilated hygrometer, and determined by Regnault's condensing hygrometer, respectively, show a close agreement; the difference of 2.1° between the means being due in part to the formula of reduction used with the dry- and wet-bulb instrument.

Columns 8 and 9 show a mean monthly difference in the relative humidity, by the unventilated and ventilated bulbs, of 10%, and an extreme difference of 26%, for a single observation, in favor of the ventilated.

Since conducting the above investigation, my attention has been called to similar work done by Mr. Sworykin in Russia. The means of fifteen observations, as given by him, are as follows: mean air-temperature, 21.5° F.; relative humidity, unventilated 59%, ventilated 55%; mean velocity of wind during the observations, 11 miles per hour.

The formulae of reduction used in this paper are those determined by Regnault. He himself declared these unsatisfactory; but they are the best we have, and certainly, as my experiments have shown, very superior to the factors of Glaisher. Many very carefully conducted observations at temperatures below 0° F., and at

Hygrometric observations at Iowa Circle, Washington, at 7 A.M., during March, 1883.

	1	2	3	4	5	6	7	8	9	10	11
	Unventilated.		Ventilated.		Dew-point.			Relative humidity.			Velocity.
	Dry.	Wet.	Dry.	Wet.	Unvent'l'd.	Ventilated.	Regnault condensing apparatus.	Unv'nt'd.	Ventilated.	8–9	Miles per hour.
								%	%	%	
March 1 .	31.0°	29.1°	30.6°	28.1°	25.3°	23.1°	24.5°	79	73	6	0
" 2 .	45.8	42.3	45.6	41.0	37.3	33.8	34.3	72	64	8	1
" 3 .	37.5	32.5	37.4	32.0	22.0	20.6	18.3	52	49	3	8
" 4 .	31.0	29.3	30.6	28.0	25.9	22.8	17.5	85	71	14	6
" 5 .	19.1	17.0	19.0	16.4	10.5	7.4	2.4	68	59	9	4
" 6 .	31.2	30.3	31.0	29.4	28.5	26.2	25.6	89	82	7	5
" 7 .	40.1	35.2	40.0	35.0	26.4	26.0	23.0	58	57	1	11
" 8 .	16 4	15.0	16.1	14.1	10.4	7.2	1.9	76	67	9	2
" 9 .	21.0	21.0	20.7	19.0	21.0	13.9	15.0	100	74	26	0
" 11 .	34.7	31.1	35.0	30.2	23.8	20.8	22.2	64	55	9	2
" 12 .	29.9	26.1	29.6	25.1	17.3	14.7	11.1	57	51	6	4
" 13 .	35.5	31.9	34.7	30.7	25.1	23.4	19.9	65	63	2	0
" 14 .	40 5	37.1	40.5	36.7	31.3	30.1	27.4	70	66	4	0
" 15 .	51.5	47.9	50.3	46.2	43.7	41.0	41.7	75	71	4	6
" 16 .	23.7	20.4	23.3	19.4	10.9	7.1	4.4	57	48	9	6
" 17 .	31.6	30.9	32.3	29.7	29.5	24.5	17.8	92	71	21	3
" 18 .	37.7	34.9	37.5	33.8	30.6	26.7	27.2	75	64	11	3
" 19 .	46.8	42.0	46.8	40.7	35.0	31.3	31.1	64	55	9	2
" 20 .	27.4	24.4	28.1	24.0	17.4	13.7	10.7	64	53	11	12
" 21 .	22.9	20.8	22.9	19.0	15.5	6.4	0.2	72	47	25	8
" 22 .	23.4	21.6	22.9	20.0	17.2	12.3	7.1	75	62	13	4
" 23 .	33.0	31.0	32.4	29.8	27.0	24.6	22 9	78	72	6	8
" 24 .	24.2	22.0	24.3	21.1	17.2	12.4	10.0	73	58	15	8
" 25 .	30.8	29.2	30.2	28.0	26.0	23.6	22.5	82	75	7	1
" 26 .	36.8	32.9	37.0	31.7	25.6	20.4	21.1	63	50	13	4
" 27 .	39.7	34.7	39.7	34.4	25.4	24.4	25.3	56	53	3	8
" 28 .	33.2	28.1	33.4	27.9	17.0	15.8	13.8	49	46	3	9
" 29 .	35.2	34.9	35.2	33.8	34.3	31.0	32.7	96	84	12	3
" 31 .	36.2	35.1	36.7	34.0	32.9	29.0	30.4	88	73	15	4
Mean . .	32.7	30.0	32.5	28.9	24.5	21.5	19.4	72.2	62.5	9.7	4.6

elevated stations, will be needed before these formulae can be improved.

The following directions may be given as essential to the satisfactory working of the dry- and wet-bulb hygrometer: —

In order to obtain accurate results, an induced air-current from 1.5 to 5 metres per second (3.4 to 11.2 miles per hour) is essential. This is needed even with moderately high wind; as experiment has shown, that, in a double-louvred shelter, with a wind of 12 miles per hour blowing directly through it, a velocity of only 1 to 1.5 miles per hour was recorded in the most favorable spot.

The thermometers should be preferably cylindrical, with the bulb removed an inch or more from the scale; and no metallic substance should be permitted near the wet bulb. The dry thermometer should be kept clean, as dust and grit would cause a deposition of moisture in foggy weather.

The muslin should be fine, and tied smoothly over the bulb. It needs cleaning as often as it appears to be turning yellow. If dust settles upon it, it can be easily cleaned with water.

Clean rain or melted-snow water should be used for wetting. A strip of cotton three-eighths of an inch wide, or a wick, will serve to make connection between the muslin and the reservoir in warm weather. If the air is very dry, this strip will cease acting; and in such case the bulb may be immersed for a moment. It will be found, that if the reservoir is kept full, and the angle of the cotton is not too great, the latter difficulty will seldom be encountered.

If any moisture is seen on the dry thermometer, it should invariably be wiped off.

If the air-temperature approaches freezing, the reservoir should be removed; though the wick may be left, its end being carried up and fastened to the frame in such a way as to permit of immersing the bulb. The water in the reservoir should be kept in the open air until a film of ice forms upon it, the intention being to keep it as near freezing as possible. The bulb should be repeatedly wet by immersion till a coating is formed, the thickness of which should depend on the difference between the dry and wet bulbs and the velocity of the air-motion; i.e., the greater the difference and the velocity, the thicker the coating. There is no difficulty with an induced air-current in obtaining accurate results with a coating 1 mm. in thickness.

If ice is found on the bulb with an air-temperature at or above freezing, it may be evaporated by the air-current, or melted off with water. The former method is preferable if the wet-bulb temperature is below freezing. If, on immersing, a drop is found at the bottom of the bulb, it can be easily removed before it freezes by touching with the edge of the reservoir.

With these precautions, an accurate determination of the moisture in the air may be made; and this must necessarily add to the value of hygrometric observations, which are so important in the study of the progress and development of storms. H. A. Hazen.

A STUDY OF THE HUMAN TEMPORAL BONE.[1]—III.

The temporal bone at birth consists of three osseous pieces suturally connected and partially anchylosed, but readily separable. The pieces are named the *squamosal*, *petrosal*, and *tympanal bones*. In some animals they remain permanently distinct, and in others are variously anchylosed. The squamosal and petrosal correspond in the main with the squamous and petrous portions of the temporal as usually described; but the so-called mastoid portion is derived from both the former. The squamosal contributes about one-third to the mastoidea, while the petrosal contributes the remainder.

The *squamosal* is a nearly circular upright plate which joins the petrosal at the *petro-squamosal suture*. This appears internally as a fissure, extending from the notch at the lower border of the squamosal, in front, to the notch at its border behind. Externally it descends from the latter notch to a position just behind the tympanal.

The mastoid portion of the squamosal is proportionately larger than later, and its auditory plate is less distinctly differentiated from the general plane of the bone. Internally it is defined by a shelf on which rests the contiguous border of the tegmen of the petrosal. Below the shelf, the auditory plate exhibits the smooth surface of the scute, which forms the outer boundary of the attic of the tympanum. The cellular portion above and behind forms the outer boundary of the mastoid antrum. The articular surface for the lower jaw is a shallow concavity, with scarcely a distinction of glenoid fossa and articular eminence; and it deviates relatively little from the general plane of the squamosal.

The *petrosal* obscurely displays the labyrinth, already of mature size and bounded by compact walls, embedded in more spongy substance, from which it may be readily excavated. The superior semicircular canal is especially conspicuous, and includes a large recess, which is subsequently obliterated. The tegmen appears as a distinct triangular plate projecting from the petrosal and overlapping the shelf of the squamosal. The tympanic cavity with its attic and the mastoid antrum are well produced, and are of nearly mature size.

The mastoid portion of the petrosal extends behind that of the squamosal, and is commonly partially anchylosed with it. Its upper extremity is notched to a variable degree; and its lower part exhibits a comparatively slight eminence, premonitory of the future conspicuous mastoid process.

The *tympanal*[1] is a horseshoe-like bone, with its ends anchylosed to the auditory plate of the squamosal. From this it slants downward and inward, and is suturally connected along its posterior and lower border with the petrosal. Its inner margin is grooved for the insertion of the tympanic membrane.

In the development of the temporal bone, the squamosal and tympanal are produced from fibro-connective tissue, and the petrosal and styloid process from cartilage. Ossification commences in the squamosal about the close of the second month of embryonic life; a centre appearing at its lower part, and extending upward in the squamous and mastoid portions, and outward in the zygomatic process. The following month, a centre appears in the lower part of the tympanal, and grows into a slender ring, incomplete above. Ossification commences in the petrosal near the middle period of foetal life. Two centres appear, and extend in the walls of the labyrinth. These centres have been appropriately named by Professor Huxley the *prootic* and *opisthotic*. They quickly coalesce to form the labyrinth, by the subsequent continued growth of which the pyramidal and mastoid portions of the petrosal are developed.

The prootic produces all that portion of the petrosal seen within the cranial cavity, except that which is contiguous to, and forms, the jugular fossa. It gives rise to the upper part of the cochlea, including its base and cupola; to the internal auditory meatus, the upper part of the facial canal and its hiatus, the upper part of the oval window, the superior and external semicircular canals, the upper arm of the posterior semicircular canal, and the tympanic tegmen.

The opisthotic produces all the petrosal seen

[1] Concluded from No. 17.

[1] Auditory process, annulus tympanicus.

beneath the cranium. It gives rise to the lower part of the cochlea, the promontory and lower part of the oval window, the round window, the lower arm of the posterior semicircular canal, the lower part of the facial canal, the jugular fossa, the carotid canal, and the floor of the tympanum.

The mastoid portion of the petrosal is produced, subsequent to the complete coalescence of the prootic and opisthotic, by outgrowths from the posterior and external semicircular canals. The outgrowth from the posterior semicircular canal first shows itself externally in the broad plate of cartilage which forms part of the cranial wall between the squamosal, the parietal, and occipital bones. It makes its appearance as an elliptical islet just in advance of the occipital. In this condition it has been viewed by Professor Huxley as a distinct ossific centre, to which he has given the name of the *epiotic*, regarding it as the specially mastoid part of the mastoid portion of the temporal bone. In my preparations, the elliptical islet has appeared as a continuous growth from the most prominent part, outwardly, of the posterior semicircular canal, after the completion of this by the co-ossification of its arms, which spring separately from the prootic and opisthotic. Later, a second element of the mastoid portion of the petrosal, as an outgrowth of the external semicircular canal, makes its appearance as a quadrate islet in the cartilage intervening to the elliptical islet and the squamosal. The two islets quickly unite, and thus together form the mastoid portion of the petrosal; the notch between them, above, still remaining at the upper extremity of the latter, at birth. From the anterior or quadrate islet, the mastoid process is subsequently developed, and not from the supposed epiotic, as has been asserted.

The squamosal and petrosal commonly anchylose in the external portion of the petro-squamosal suture, near the time of birth; and this portion of the suture is usually obliterated during the first or second year subsequently. Sometimes traces of it remain as irregular chinks, and rarely the greater extent or the whole of it may be retained, as represented in the accompanying fig. 3, from one of several similar specimens in the university museum. The suture is observed to descend from the notch at the upper border of the bone to the point of the mastoid process; and it thus indicates that the anterior third of the mastoidea pertains to the squamosal, while the rest alone belongs to the petrosal. The internal portion of the suture, commonly after some years, is but partially obliterated, and frequently remains, to a variable extent, as a fissure defining the tegmen of the petrosal from the inner surface of the squamosal.

The mastoid process, scarcely marked at birth, becomes conspicuous only after a year or two. The mastoid antrum is developed at birth; but the surrounding mastoid cellules undergo but little development until after puberty.

The external auditory meatus is produced after birth. The auditory plate forming its roof is gradually more differentiated from the rest of the squamosal, and its tympanic scute becomes more distinct by the production of spongy substance between it and the roof of the meatus. The floor and sides of the latter are produced from the tympanal ring, which becomes the tympanic plate of the more mature bone. Lateral processes grow outwardly from the ring, expand at the ends, and conjoin to form the auditory process, leaving an aperture in the tympanic plate. The aperture is obliterated about the third or fourth year, but occasionally is retained as an imperfection, closed by fibrous membrane. From growth downward and backward from the tympanal, the vaginal process and posterior extremity of the tympanic plate are produced.

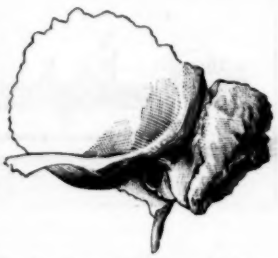


FIG. 3.—Temporal bone, one-half size, exhibiting the outer part of the petro-squamosal suture, permanently retained, and indicating the division of the mastoidea into a squamosal and a petrosal portion.

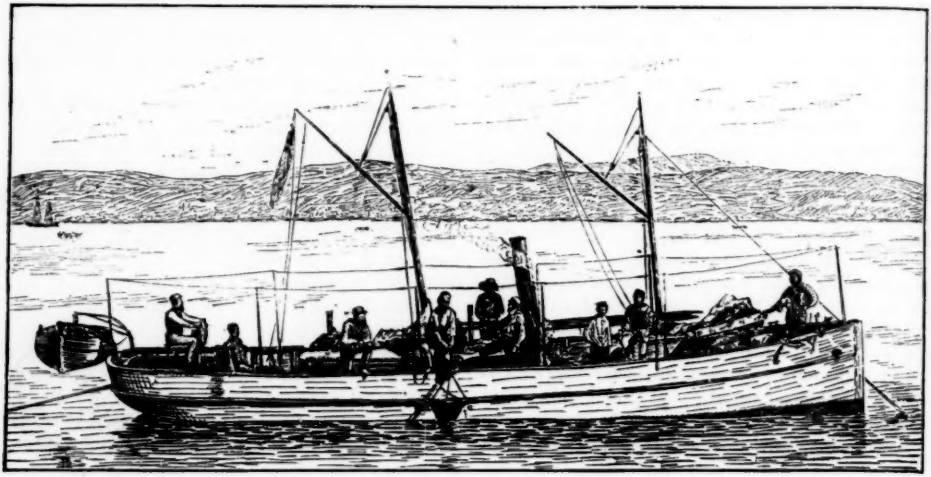
JOSEPH LEIDY.

THE NAPLES ZOÖLOGICAL STATION.[1]

II.

THE fleet of boats belonging to the station, to whose efficient services the constant supply of material is due, consists of two steam-launches and a number of row-boats and sail-boats. The larger of the steamers, named, after the great German biologist, 'Johannes Müller,' was given by the Berlin academy of sciences; while the smaller, the 'Francis Balfour,' was bought by the station. These are used for long excursions, being absent in summer sometimes for three or four days.

[1] Concluded from No. 17.



THE JOHANNES MÜLLER.

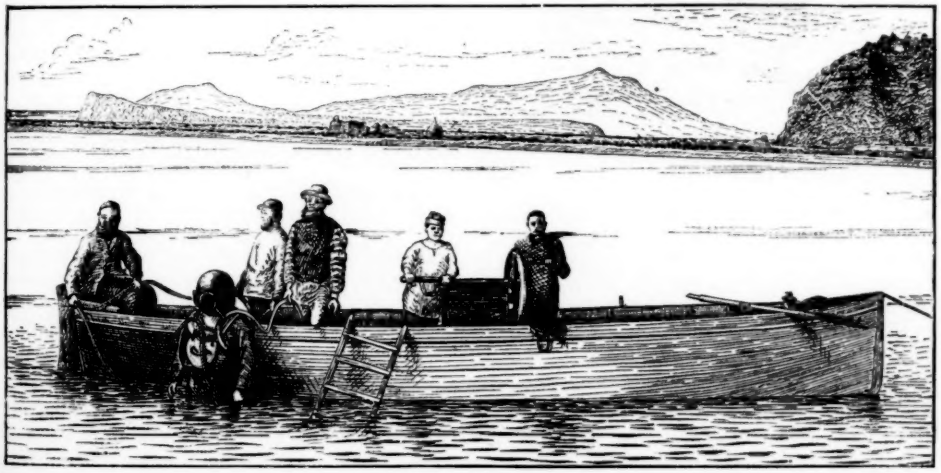
The smaller boats are used for shorter distances and for surface-netting, by which is obtained the heterogeneous collection of large and small pelagic animals known as *auftrieb*, and brought into the station every day in fair weather. A vessel full of the auftrieb is taken to the occupant of each table in order that he may search for free larvae, if he happens to be studying the embryology of animals which leave the egg at an early stage, or may study the many curious pelagic animals which cannot be kept in captivity, and only occur from time to time in the contents of the surface-nets. The larger pelagic animals — such as large medusae and ctenophores — are separated from the auftrieb for the use of those who happen to be specially engaged in their study. But among the many minute creatures which are to be found in it at various times may be mentioned the winged, free, swimming mollusks of the class Pteropoda, known to the Neapolitan fishermen as *farfalle di mare*, or sea-butterflies; the other class of free, swimming mollusks, Heteropods; the free, tailed ascidians, Appendicularia; innumerable species of small medusae, — some adult, some the young stages of the fixed Hydrozoa; and transparent crustaceans of various sizes of the class Copepoda, which are never wanting.

The greatest possible care and attention is given by the attendants, and by the gentlemen of the staff, to the requirements of each zoölogist in the station, with respect to material. If unfavorable weather prevents fishing-operations, or if the animals required are rare, whatever is at hand in the preserved state is placed at the disposal of the investigator; and advice as to methods of preservation and treatment, and information as to the breeding-times and seasons of frequency or rarity of the inhabitants of the gulf, are always offered with the greatest freedom and courtesy. By writing beforehand, a naturalist about to work at the station may insure having material — living and preserved, adult and in the young stages — ready for him on his arrival, so that he can commence his researches at once. But the zoölogist who occupies himself at the station is not merely a passive recipient of the benefits of its organization. Every opportunity is given to him to study its whole working, and to take an active part in the fishing and dredging operations. He is invited to accompany the members of the staff on the steamers on excursions in the bay and to various points on the coast or neighboring islands, — to the Bay of Salerno, to Capri, to Ischia, — in order to see how the different kinds of apparatus are worked, and, if he pleases, to descend, equipped in the diving-dress, and examine the bottom of the sea with his own eyes. The beauty of the scenery and climate, the congenial society, and the interest attaching to the operations, combine to render these excursions the most pleasant events in the course of a visit to the zoölogical station.

A zoölogist obtains the privilege of working at the station by application to some institution

in his own country which has the disposal of a table: in the majority of cases, the application has to be made to the government. The station lets its tables to scientific corporations or to governments at a yearly rental of four hundred dollars each. There are, at present, twenty tables taken, of which the greater number belong to Austria, Germany, Russia, and Italy. Holland and Belgium have one each, and England has two. There is room in the station for thirty. The rapid development of the institution is shown by the fact, that, when it was first opened (in January, 1874), only seven tables were taken. About two hundred and thirty biologists — among them, very many of the highest eminence — have worked in the laboratories of the station in the nine years of its existence; and the published works founded on the studies so carried out form a considerable proportion of the total addition to biological knowledge produced during that period. The brilliant researches of Francis Balfour on the development of elasmobranchs, which formed such a large step in the progress of vertebrate embryology, were carried out chiefly during the time he spent at the table of Cambridge university, in 1874, 1875, and 1877; and he always fully acknowledged the debt he owed to the zoölogical station and its staff. Professor Grenacher commenced his researches on the eyes of arthropods at the station in 1876, — researches which resulted in his classical work, which is, up to the present, the principal authority on the subject. The brothers Oscar and Richard Hertwig carried out their interesting work on the histology of the Actiniae at Naples. F. E. Schultze and Oscar Schmidt, two of the principal living spongiologists, have availed themselves of the resources of the station; and Professor Claus, Dr. Hubrecht, Dr. Spengel, and Dr. Chun are other names whose celebrity in zoölogy is connected with the institution. Last year an American zoölogist, Dr. Whitman, carried out some important researches in the Naples laboratory on the curious parasites, Dicyemidae.

The number of those belonging to the permanent scientific staff of the station is eight, including Mr. Petersen, the engineer, to whose skilful and successful management of the machinery the wonderful regularity and efficiency of all the mechanical arrangements is due. The other seven are biologists who are occupied in the preparation of monographs of various classes, for the series published by the station; while they divide among them the work connected with the issue of the two periodical publications, and the routine duties of the laboratories. Dr. Dohrn acts as director, and represents the station to the outside world; while the chief duties of management devolve on Dr. Eisig, to whose devotion and foresight the enterprise owes much of its success. The duties of librarian are discharged by Dr. Brandt, whose name is well known in connection with the recent discoveries that have been made, as to the existence and significance of symbrosis in animals, and who is engaged at present on the monograph of the radiolarians of the gulf. Dr. Lang, in the



THE DIVER'S BOAT.

course of his work on the turbellarians, has already produced some extremely important papers on their morphology, and the relations of plathelminths generally. The monograph of Dr. Mayer, on the curious crustacean family Caprellidae, has just appeared, and the 'Copepoda' of Dr. Giesbrecht is rapidly approaching completion. To the two zoölogists last named belongs the credit of most of the great improvements in technique which have been invented in the station. The value of these improved methods can scarcely be overestimated. Technical difficulties often stand in

THE STATION FISHERMAN.

the way of the solution of definite and important questions: before them the investigator is brought to a stand-still, and his advance in the desired direction hopelessly blocked. The discovery of a rapid and certain method of obtaining series of sections, which science owes to Dr. Giesbrecht, has given a new power to research, and enabled investigations to be undertaken which before were impossible.

The publications of the station have already been mentioned, but it is well to add a few details concerning them. The monographs are intended to form a series of complete studies of every group of animals existing in the gulf, and to contain a body of accurate information on the anatomy, histology, classification, and relations of marine forms, which shall serve as a sound basis for future investigations. The series includes Algae as well as animals. They may be written in either of the four generally known European languages. Six have already appeared, the first being the beautiful work of Dr. Chun on the Ctenophorae. One by Dr. Emery has already appeared in Italian; and the Actiniae of Dr. Andres will shortly be published in the same language. They are published by subscription, of which the annual amount is $12.50, and the number of subscribers, up to the present, is two hundred and sixty. The station also issues a journal for original memoirs of work done in its laboratories, called the 'Mittheilungen aus der zoologischen station,' which commenced in 1879, and whose three volumes contain already much important work; also a bibliography, called the 'Zoologische jahresbericht,' in which every paper on biological subjects is not only indexed, but summarized. The latter was commenced in 1880.

It will be allowed that the zoölogical station has already a many-sided activity; that it has done, and is doing, a great deal for biological science; nevertheless, it is about to take a still further expansion. A separate laboratory is in course of preparation for the study of comparative physiology, for which nowhere such favorable conditions could be found as will be provided by the resources of the existing station. Every one who is a friend to the progress of biology must wish the Neapolitan station success in its new enterprise, and a continuance of the successful development which has, up to the present, taken place in the original institution.

Emily A. Nunn.

EVIDENCES OF GLACIATION IN KENTUCKY.

The following notes of observations on glacial action south of the Ohio River are submitted to the fund of evidence of glaciation anterior to the period of the great terminal moraine.

1. At the crossing of the Kentucky River by the extension of the Kentucky Central R.R., opposite the mouth of Otter Creek, and in Clark County on the north bank of the river, the following fresh section was obtained at the mouth of the railway-tunnel.

	Thickness.
Beneath the surface-soil, yellowish clay, with layers of gravel in the lower portion, and in patches through it	20 ft.
True drift clay, bluish, with smoothed and striated gravel; small bowlders of limestone; one large bowlder of blue limestone of several tons' weight; together with many smaller ones which had been partially removed	5 ft.
Limestone in thin layers to level of railway,	3 to 7 ft.
Above the bed of the river	61 ft.

This locality is sixty miles south from the crossing of the Ohio River by the grand moraine.

2. In Rock Castle County, at the summit of the Knoxville branch of the Louisville and Nashville R.R., between Roundstone Lick and Pine Hill, is a hill of modified drift, mainly composed of detritus derived from lower coal conglomerate and limestone. The railway cutting revealed some twelve feet in thickness of this material.

3. At the crossing of Rock Castle River by the same railway, polished and striated blocks of subcarboniferous limestone *in situ* were seen after removal of the superimposed clays. The striation of these blocks may be due to ice moving down the river, though it is doubtful if river-ice has ever weight enough to do much smoothing and striating work.

4. At the Hazel Patch summit of the same branch railroad, on the highest portion of the Cumberland plateau in Laurel county, a cut of the road revealed a low moraine composed of fragments of carboniferous slates and sandstones, and of the upper coal of this portion of the county. In riding over this plateau two years ago, I encountered this moraine, and then traced it east and west for some distance, suspecting its ice-origin. Subsequent work on the line of the railway confirmed my suspicions.

5. In the summit between Laurel branch of Rock Castle River, and Lynn Camp branch, a heavy bed of glacial clay was encountered, showing the worn-off edges of coal-seams on their northern aspect, and fragments mingled with the clays, similar to coal-beds and clays to be seen almost anywhere in Ohio.

My notes of these two last localities having been mislaid, I cannot describe the sections in detail.

These clay-beds cannot be referred to clays derived from decomposition of shales and marls of the coal strata. The latter are always found *in situ*, while the glacial clays may repose upon coal, sand-rock, limestone, or any other strata of the county, so that there is no danger of confounding the two. If the recent cuts of railways in construction and of those lately completed were closely examined, the surface geology of Kentucky would doubtless reveal many other localities where glaciation could be studied to advantage.

R. P. STEVENS.

EARLY DEVELOPMENT OF REPTILES.

W. F. R. WELDON publishes a valuable article on Lacerta muralis (*Quart. journ. micr. sc.*, xxiii. 134). His clearness and conciseness contrast very agreeably with the prolixity of many embryological writings. At the close of segmentation the ectoderm consists of cells very irregularly arranged, often two layers deep. The entoderm is also irregular and two or three cells thick. The area pellucida is formed by the outer cells becoming more columnar, and the inner cells more regular. Soon the posterior end of the area is marked by the presence of the primitive streak, which is a mass of closely packed cells, exhibiting no division into layers. The blastopore commences at the anterior end of this streak as a pit, open above, closed below. The floor of the pit breaks through, and the blastopore assumes its normal condition, forming a communication between the exterior and the primitive entodermic cavity. The mesoderm arises as two lateral outgrowths from the primitive streak, afterwards from the sides of the blastopore, and the axial strip of invaginated hypoblast. Anteriorly the mesoblastic elements are branched cells, which are budded off from the entoderm. (Do not these correspond to Hertwig's mesenchyma?) Weldon confirms Balfour and Stahl's account of the development of the allantois as a process of the primitive streak.

Having examined younger embryos than Braun, Weldon is able to rectify the former's account of the origin of the Wolffian duct and renal tubules. The protovertebrae are connected by an intermediate cell-mass with the lateral mesoblast. In this intermediate mass there appears a series of cavities, each opposite a protovertebra, and separate from one another. They are the segmental vesicles described by Rathke and other writers. When twelve protovertebrae are present, the Wolffian duct begins to appear as a solid cord of cells, splitting off from the intermediate cell-mass, and passing, therefore, into the dorso-lateral wall of each segmental vesicle. The duct develops, acquiring a lumen in the intervertebral spaces first; but, when there are fifteen protovertebrae, it becomes a continuous canal through the first eight segments, and acquires at the same time communication with each segmental vesicle. Back of the eighth segment the development is similar, except that the duct grows independently of the vesicles. This agrees with Sedgwick's observations on the process in birds and elasmobranchs.

Another paper on this subject has been published by Dr. H. Strahl (*Arch. anat. physiol., anat. abth.*, 1883, 1). As an introduction, he gives notices of previous researches on the same theme. Then follows a chapter of general remarks, in which the gestation, growth, and gross changes of the embryos, and the manner of obtaining them, are considered. The main part of the article is devoted to a detailed account of the new observations, prefaced by a summary of the results previously obtained by himself. The new part begins with the stage when the blastopore or neurenteric canal is completely formed. The principal new results may be summarized as follows: in the neurenteric canal, two

parts may be distinguished, — one vertical, descending from the blastopore; the other horizontal, running forwards. In the dorsal wall of the latter, the chorda dorsalis makes its first appearance. The canal closes at the same time as the medullary tube. Just before the closure of the blastopore, the 'anlage' of the medullary cord extends around it. After the external closure, the communication between the medullary tube and the digestive cavity is still maintained by the canal. Strahl uses the unfortunate term 'medullary cord' to designate the medullary tube, notochord, and part of the primitive streak together: hence he describes the chorda as being differentiated from the medullary cord. This only adds to the confusion, and is the more to be regretted, since the real origin as described by him agrees with the accounts of other writers, — it is at first a modification of the epithelium of the neurenteric canal. The middle portion of the chorda is the first to be grown over by the entoderm: therefore the two ends remain longer uncovered than the middle. At the time when the peripheral mesoderm, forming the area vasculosa, reaches the germ-wall, the latter is already completely fissured. Blood-vessels have begun to appear before this time, and without the participation of the germ-wall. C. S. Minot.

THE INTERNATIONAL GEOLOGICAL CONGRESS.

The compte rendu of the second session of this congress, held at Bologna last year, has just appeared in a thick octavo, with abundant illustrations. The history of the congress, forming the first part of the volume, was prepared by the president, Capellini, and consists of a brief account of its origin with the meeting of the American association for the advancement of science in 1876, a summary of the results of the first meeting at Paris in 1878, a list of the members and officers of the first congress, an account of the choice of Bologna as the rendezvous for the second meeting, of the nomination of the international commissions, of the organization of the second congress, with its rules and regulations, and lists of the members, delegates, and officers. In connection with this latter portion, it is curious to note that a number of the more eminent geologists who originally took part in it no longer belong to the congress; and also that the number of Italians at the congress was 202, although the geological society of Italy has only 120 members, of whom 14 are foreigners.

The second part, prepared by Delaire and Fontannes, besides the proceedings at the different sittings, contains a number of appendices on geological coloring and nomenclature, and one on the classification of mineral masses by M. de Chancourtois, accompanied by a tabular view of lithological synthesis. This author objects to the indiscriminate use of the word 'rock,' and proposes instead the word 'lithe,' which he subdivides, according to the origin of the rock, into analithes, endo-analithes or endolithes, exo-analithes or exolithes, catalithes, peri-catalithes or perilithes, apo-catalithes or apolithes. The reports of the discussion are interesting, as showing the extreme difficulty of reaching any unity in classifications, even on the most trifling points.

The third part (documents of the congress, prepared by the same hands) contains a brief description of the collections and maps exhibited at the congress. Among these may be mentioned the geological map of Italy (scale, $\frac{1}{1,111,111}$), engraved in the colors of the international commission, especially for the congress, in two editions, — one with the mountains figured in hachures, and the other without them. The latter is the clearer, and preferable as a geological map. It is curious that a map on a scale so small should have twelve colors devoted to crystalline rocks, and only ten to the sedimentary strata; and it answers well its purpose as a study of geological map-coloring. The Italian committee also prepared a geological and paleontological bibliography of Italy, containing mention of 6,566 memoirs from the days of Aelianus (693 B.C.) to 1881. Its arrangement is remarkably clear and simple.

The fourth part (annexes) contains *in extenso*, and in their original language, the reports sent by the national committees to the international commissions established in 1878. They are followed by summaries of a few individual reports on the unification of nomenclature, or of graphic processes.

The scientific communications are the following: 1°. Macrographical classification of the trachytes of Hungary, by J. Szabó, already mentioned in Science. 2°. On the classification of the ancient stratified rocks of the island of Sardinia, by J. G. Bornemann, who has found a number of primordial fossils, paradoxides, etc., with intercalation of the second fauna. This would seem to be analogous to the condition of the Taconic of Vermont. 3°. On the cretaceous system and the great sand-dunes of the northern Sahara, by G. Roland. He considers the cretaceous as consisting of the middle and upper divisions; that the sand-dunes constitute distinct chains, formed entirely by the wind, and depending for their orography on topographical accidents; that the larger dunes are not moved by the action of the wind, the position of the masses, and the orography of the chains, varying but little, excepting that, as a mass, they are very slowly travelling toward the south-east, and the quantity of sand is continually increasing. 4°. Memoir on the geology of New South Wales, by C. S. Wilkinson, who recognizes all the great divisions, from the Silurian to the tertiary inclusive, and confirms the truth of the report of the late Rev. W. B. Clarke of the association of triassic plants with the marine carboniferous fauna.

Next follows an account of the three excursions taken by the congress to Florence, Pisa, and Carrara. Accompanying the latter is a section from Carrara to the central region of the Alpi Apuane, in which the Carrara marbles are shown to be of triassic age; fossils of this age being found in, above, and below them.

We next have the prize memoirs on the unification of graphic processes in geological maps. The best was considered to be that by A. Heim; next comes the one by A. Karpinsky, and, lastly, that by M. Maillard. Mr. Heim's memoir contains a plate exhibiting the application of his system to profile sections, which is very clear and plain.

The last or fourth part contains numerous reports on geological nomenclature and coloring of more or less importance. It does not seem to have occurred to the congress to compare the different methods in actual use by the different geological surveys. None of the different reports seems to give these, except that by Major J. W. Powell of the U. S. geological survey. The difficulty, with our still imperfect knowledge of geology, of establishing any system of universal application, seems very great, and is well illustrated by Professor Hébert when he expressed the ingenious wish that votes should only be taken on those points on which all are agreed.

In conclusion, we may mention the very sensible motion of Mr. Torel, that the congress, while leav-

ing to the organization committee of each session the care of detailing its programme, desires that in future a place should be reserved for purely scientific studies, besides the works of unification; and also wishes, that following the example given at Bologna, an exhibition of collections and maps should accompany each session of the congress. J. B. MARCOU.

DEVELOPMENT OF THE MEMBRANE-BONES OF THE SKULL OF THE PIKE.

IN an inaugural dissertation presented to the faculty of the university of Jena, which has been published separately, and also in the *Jenaische zeitschrift* (xvi. 59–87, 1882),[1] with two excellent plates, Johannes Walther discusses this subject very ably, and reaches the following conclusions, which are probably of considerable importance as leading to important general views respecting the development of the membrane-bones of the skulls of Teleostei.

The skull of the pike (Esox lucius) consists of membrane and cartilage bones. The former develop in the following ways: 1. As cementum-bones, by the coalescence of osseous cementum-plates developed below the bases of the teeth, which are formed in invaginations of the oral mucous membrane; 2. As membrane-bones in the subcutaneous connective tissue, independently of any antecedent development of teeth; 3. As perichondrial bones, like the last, but in a deeper layer in contact with the perichondrium. These three modes of development of the parts of the osseous skull are connected together by transitional modes. According to a fundamental biological law, as well as in view of the evidence afforded by the studies of O. Hertwig in the comparative embryology and anatomy of the scales, dermal scutes, etc., of fishes, the preceding types of osteogenesis constitute a series of stages which correspond to the phylogenetic mode of evolution of the bones in question.

The cartilage-bones of the pike's skull develop outwards from the perichondrium, though there is a centripetal growth of osseous tissue during which the cartilage is absorbed. The origin of bone-corpuscles inside of cartilage, or enchondrally, was not observed in any of the stages investigated. The vomer, palatine, and dentary bones are conspicuous instances of the first-mentioned mode of ectosteal development from the fusion of basal, osseous, tooth-supporting plates, which the author regards as representing the cementum. The maxillary, jugal, frontal, nasal, parietal, and parasphenoid bones, although not ontogenetically developed in this way, are true membrane-bones, and are derivable primarily or phylogenetically from coalesced basal dentary plates.

The author finds an enamel cap surmounting the conical hollow dentinal bodies of the teeth which contain the pulp. The conical dentinal cap is the first part of the tooth to be formed; the enamelled tip is then developed previous to the anchylosis of the whole to the osseous basal plate, the dentine growing downwards to meet the latter.

The paper also contains observations on the development of the teeth of the young trout, California salmon, common salmon of Germany, and the eel. The morphology of the skull of Esox is very fully and admirably treated, the histological details and crania of the larval stages figured and described constituting a real addition to our knowledge.

J. A. RYDER.

[1] See also SCIENCE, ¶ 738.

LETTERS TO THE EDITOR.

Rainbow.

LAST evening I observed what to me was a new phenomenon. The day had been clear. Towards sunset the sky clouded in the west with rain-clouds, so that the sun appeared through them only as a white spot of light. The clouds were continuous, but uniformly lighter from the horizon upwards. At quarter of seven o'clock a rainbow, faint, but still distinct in form and color, was visible above and to the northern side of the sun. It extended, perhaps, something less than two-thirds of the way from the horizon in the north to that in the south. The phenomenon is of course easily understood, but is it common?

W. J. L.

Andover, N.H., May 15, 1883.

Nemestrinidae.

In the notice of Handlirsch's discoveries as to the life-history of Hirmoneura obscura (SCIENCE, p. 332), I stated (following Osten Sacken's catalogue) that Hirmoneura was the only genus of Nemestrinidae in the United States. Dr. Williston kindly reminds me that I overlooked his description of Rhynchocephalus Sackeni from Washington Territory, published in 1880 (*Trans. Conn. acad.*, iv. 243). He now publishes (*Canadian ent.*, April, 1883) a paper on the North-American species of that family, in which he describes from my collection a third species; viz., Rhynchocephalus volaticus from Florida. While speaking of this dipterous family, I would also mention that Baron Osten Sacken (*Wiener ent. zeit.*, ii. 114) calls attention to a short communication by E. L. Arribalzaga, published in *El naturalista Argentino*, i. 275 (1878), on the life-history of Hirmoneura exotica Wied., which oviposits in the galleries of a carpenter-bee (Xylocopa augustii St. Farg.). This last constructs its cells in fence-posts and in the wood-work of buildings. Nothing further is stated by Arribalzaga; but the young larvae doubtless leave the burrows, and otherwise resemble those of H. obscura.

C. V. RILEY.

Intelligence of the crow.

In SCIENCE, Nos. 13 and 16, are letters bearing this title, in the former of which the writer refers to crows assaulting him while walking in Rome by attempting to drop stones upon him as they circled above. The author of the second letter takes exceptions to the statement, especially to that part of it averring that the crows dropped the stones *from their claws*, and thinks the narrator must have been 'mistaken in the bird,' basing his belief on his own experience with crows and ravens in confinement, which he has observed always to use their *bills* in transporting objects. Whatever the crows may 'do in Rome,' it is well attested that rooks (Corvus frugilegus), which are true crows, have been seen to carry mussels from the beach to a considerable distance into the air, and let them fall among stones to break the shells, so as to get at the contents. Gulls are well known to occasionally resort to the same practice. Although in neither case do the accounts I have seen state explicitly how the mussels are carried, the inference is that they are taken in the bill. Yet as woodcocks have been seen to transport their young by flying with them supported between the feet, it is obviously unsafe to dogmatize as to what a given species of bird may or may not be able to do.

J. A. ALLEN.

STUDIES IN LOGIC.

Studies in logic. By members of the Johns Hopkins university. Boston, *Little, Brown, & Co.*, 1883. 7 + 203 p., 2 pl. 16°.

Mr. C. S. Peirce and four of his students, present or recent members of his logic classes at Baltimore, offer us in this work six distinct essays on topics of recent logical theory, besides three shorter contributions classed as notes. The volume is throughout studiously unpretentious and very solid work, that might have made much greater claims with perfect safety. The style is extremely compact, and the purchaser of the book will pay for no padding.

Four of the longer studies appeal only to very special students. The two others, Mr. Marquand's essay on the 'Logic of the Epicureans' and Mr. Peirce's very important study of the logic of induction, entitled 'A theory of probable inference,' will interest the general student either of philosophy or of scientific method.

Mr. Marquand's essay on the Epicurean logic opens the book, and gives us an account of the Epicurean theory of induction as it is stated in the work of Philodemus, that has been preserved in fragments in a Herculaneum papyrus. One could wish that this essay had been fuller upon some points; but as a whole we must accept it with thankfulness, as containing useful and not otherwise so easily accessible information. Mr. Marquand then discusses a 'Machine for producing syllogistic variations,' and adds a 'Note on an eight-term logical machine.'

Then follow two 'Algebras of logic,' by Miss Christine Ladd (now Mrs. Fabian Franklin) and Mr. O. H. Mitchell respectively. These are new structures on Boole's foundation. Miss Ladd uses two copulas, expressed by the symbols $\bar{\vee}$ and $\vee$. With these she is able to write algebraically all the old forms of statement, and to perform the customary operations of symbolic logic with great brevity and facility. The copula $\bar{\vee}$, a wedge, is used to signify exclusion. $A \bar{\vee} B$ means that A is wholly excluded from B; i.e., that no A is B. This copula is not to imply the existence of the terms of the statement. The copula $\vee$, an incomplete wedge, is the symbol of imperfect exclusion. $A \vee B$ means that some A is B. And this copula is taken to imply the existence of the terms of the statement. The symbol ∞ is used for the universe of discourse. The symbol 0 finds no use in this algebra. $x \bar{\vee} \infty$ expresses the non-existence of the class x; and this is written more briefly $x \bar{\vee}$. The notation thus established has the convenience that $a \bar{\vee} b = ab \bar{\vee}$, $abc \bar{\vee} = a \bar{\vee} bc$, etc., and, with a corresponding notation for the other copula, $abc \vee = a \vee bc$, etc.; so that the factors of an excluded or not excluded combination may be written in any order, and the copula may be inserted at any point or written at either end. The notation is further applied to combinations of propositions, and to the processes of elimination; and the relative simplicity of expression is preserved throughout.

Mr. Mitchell expresses propositions as logical polynomials, consisting of sums of terms, formed after Boole's fashion. The classes indicated by the polynomials are stated in the propositions to form either the whole or some part of the universe of discourse. Thus, the proposition that the universe $U = \bar{a} + \bar{b}$ would mean that no a is b. Such a proposition Mr. Mitchell expresses by the notation $(\bar{a} + \bar{b})_1$; or, in general, if F be any logical polynomial, F_1 means that F precisely fills up the universe. F_u would express that F forms some part of the universe. $\bar{F}_u$ means that $\bar{F}$ forms part of the universe. Propositions thus formed are used for the purposes of inference in a simple way, expressed in Mr. Mitchell's words by the rule, "Take the logical product of the premises, and erase the terms to be eliminated."

The foregoing may serve to suggest to any one acquainted with Boole's notation the drift of the innovations proposed in these two algebras. Psychological importance, as Mr. Peirce himself suggests, these two notations can hardly claim. They tell us nothing new about the nature of the thinking process, but are interesting only as ingenious and possibly useful methods for expressing very briefly complex facts and elaborate logical calculations. As such expressions, they will hold their own, and may even be noticed in that not very distant time when the whole earth shall be filled with logical algebras, whereof there shall be, for all we can now see, as many as there are tiles on the roofs of the houses.

Mr. B. I. Gilman's very special study follows, on 'Operations in relative number, with application to the theory of probabilities.' Then comes the strong piece of the book, Mr. Peirce's before-mentioned discussion of the logic of induction. This we have read, not with entire conviction, but certainly with no little admiration. Readers of Mr. Peirce's fine papers called 'Illustrations of the logic of science,' in the *Popular science monthly* of

some years back, will be glad to find here, in a more elaborate and technical form, the theory of induction that was outlined in one of those papers. It is, philosophically considered, the most ingenious account of the subject that we have anywhere read; but, as said, we still hesitate to accept this account as complete. But space forbids any lengthy statement of our difficulties in this connection. We must be content with few words.

Mr. Peirce brings the theory of induction into direct connection with the general theory of probable inference, but does so in a way of his own. He rejects, in the first place, any notion that the occurrence or non-occurrence of an event in the past in any way affects the probability of its occurrence in the future. The doctrine of inverse probabilities, as it has hitherto been applied, Mr. Peirce considers as furnishing no foundation for the theory of induction, and equally does he reject our old and trusted friend, the postulate of the uniformity of nature, as the basis of inductive inference. One may well ask, remembering Hume, what yet remains when these faithful allies have failed. But Mr. Peirce's insight finds yet another resource, — not the probability that a given event will be repeated in the future, but the probability that a given form of inference would, in any constitution of the universe whatever, tend in the long-run to lead us to truth rather than to error: this is, for Mr. Peirce, the ground of the true inductive inference. Thus, then, the universe need have no peculiar constitution to render inductive inference valid.

The inductive inference, then, is to be expressed as one form of probable inference. Simple Probable Deduction is exemplified in the typical syllogism:

The proportion ρ of the M's are P's;
S is an M;
It follows, with a probability ρ, that S is a P.

This means that the conclusion, S is P, would in the long-run, and if S is chosen at random, be true in a proportion, ρ, of cases. — More complex is Statistical Deduction, of the form:

The proportion r of the M's are P's;
S′, S″, S‴ are a *numerous* set, taken at random from among the M's:
Hence, probably and approximately, the proportion r of the S's are P's;

that is, the more M's we choose at random, the more likely it is that the same proportion of P's will appear among the chosen M's as exists among the whole actual number of M's. — But now suppose, that, knowing nothing of the real proportion of P's among the M's, we undertake to discover this proportion by sampling the M's. Then we have but to employ our previous principle, and say that the more M's we choose at random, the more will it be likely that the proportion of P's among the chosen M's will equal, and so will reveal, the actual proportion of the P's among all the M's. But now we have induction. We do not assume any thing about the constitution of the unknown parts of the class M. We make no postulate of the 'uniformity' of the class M. That I have found one M that is P, or more, makes it no more probable that the next M found will be P. But we conclude only that the conclusion reached in the following syllogism is reached by a method or precept that must in the long-run lead us towards truth, and away from error. The typical inductive syllogism is:

S′, S″, S‴, etc., form a numerous set, taken at random from among the M's;
S′, S″, S‴, etc., are found to be — the proportion ρ of them — P's:
Hence, probably and approximately, the same proportion, ρ, of the M's are P's.

Thus sampling, continued and fair, tends toward truth, and gives us justifiable ampliative inferences, whatever the constitution of the things about which we infer. Mr. Peirce applies a similar analysis to the form of induction which he calls hypothesis.

This is a very inadequate sketch of a view that deserves serious attention. Of all attempts at a purely empirical theory of our knowledge of nature, this is one of the most promising. We should be sorry to prejudge it in any way by adding to our lame exposition hasty criticism; but, when we say that the theory seems to us to fail just at the most important point, we express what, fairly or unfairly, many readers will feel. The most important point lies in the words 'chosen at random.' Mr. Peirce himself, with perfect fairness, suggests some of the difficulties involved in this word. 'Sampling,' he says 'is a real art, well deserving an extended study by itself.' But does not this art depend for its very existence on an *a priori* assumption about the structure of the universe? Is not a world of which we know that in it we can choose our S's at random from among the M's a world of which we already must know a good deal? Mr. Peirce makes one admission about such a world. It is, he tells us, a world in which we must assume that there are no supernatural and malignant powers at work confusing our choice; i.e., making our supposed random

choice really unfairly predetermined and so deceptive. If, he thinks, the supernatural powers let us alone to choose for ourselves, then our inductions, properly guarded, will inevitably lead us in the direction of true conclusions, whatever the arrangement of the real world. But has Mr. Peirce made all the necessary admissions? Would a devil be needed to confuse my efforts at sampling, so as to make my choice unfair? Would not an instinctive interest in one class of cases serve to vitiate the fairness of my observations in cases where this instinct controlled me? Suppose that by instinct I took such interest in the cases of M's that are P that I noticed no cases, or very few cases, of M's that are not P, however many there might actually be: then, unless I were conscious of this instinctive preference, I should go on neglecting numberless cases that I ought to have taken into account in forming my induction; and yet, not knowing my own natural defect, I should think that I was choosing my cases wholly at random. Here would be a constant error in the process, whose magnitude might be enormous. Yet the error could never be discovered, save by some one to whom a new mental growth made possible the discovery of the instinct. But this case is no factitious one. Our observation of nature is doubtless determined throughout by our natural interests in things. These interests are instinctive, and they may exclude from the very possibility of notice very many facts. Thus, a person that by nature is indisposed to notice the double images in the binocular visual field will study his field of vision for a long time, and will assure you that there is no doubleness there. Might he not say, that after making at random many trials, and finding no double images, he was warranted in the conclusion that for him the proportion of double images in the visual field must be extremely small? Yet once begin to notice the doubleness, and the double images will be found in multitudes, like the chariots and horses that Elisha's servant saw when his eyes were 'opened.'

When we conclude that continuous random sampling of a given natural class must lead us towards discovering the true proportion of cases of the presence of a predesignated character in individuals of the class, must we not base our conclusion on the ultimate *a priori* assumption that our instinctive tendencies to observe natural facts are such as, in the long-run, will lead us to actual choicé at random, and not to a choice unconsciously vitiated by unknown preferences for cases that favor the conclusion that we reach? And is not induction, therefore, still dependent on an *a priori* assumption about the nature of reality? J. J. G.

But these inadequate negative suggestions must not give the impression that the foregoing is the whole substance of this very compact essay, which is full of valuable thoughts upon scientific method, and which must be read in detail to be appreciated. We hope for much more such work as this book contains, for the result cannot fail to be of value alike to American science and to American philosophy. Those who oppose a purely empirical philosophy must still be aided by finding so able a defence of some of its doctrines, and those who believe in other forms of logical doctrine cannot afford to remain ignorant of the advances of symbolic logic.

THE RACES OF MEN.

Les races humaines. Par Abel Hovelacque, professeur à l'École d'anthropologie. Paris, *Cerf*, 1882. 159 p., illustr. 16°.

This rather attractive work is written on a practical plan, which is specially useful in tending to correct the false impressions generally entertained, connected with the term 'race.' It is strictly limited to ethnography as distinguished from ethnogeny and ethnology, and simply considers the actual divisions of mankind, with their geographical areas, and their physical, intellectual, and moral characteristics. In the classification of races, the old division by color — as white, yellow, black, etc. — is repudiated; the fact being established, that other characteristics, such as those relating to the hair, to the shape of the cranium, and to height, are equally important, and that none of them can be exclusively adopted in class arrangement. Failure likewise attends a merely linguistic and a strictly geographical grouping. The attempt to discuss races in the order of their development toward civilization would seem to be philosophic, but meets with the difficulty that bodies of men, who, by all other considerations are to be included in the same race, are at wholly diverse degrees of progress in civilization. Admitting, therefore, that no single criterion is possible, the author decided to take account, with due weight, of all the different elements of classification, and to leave to the presentation itself, by its success, the responsibility of justifying its own order.

Professor Hovelacque's arrangement, as distinguished from strict classification, is as follows: 1. Australians; 2. Papuans; 3. Mela-

nesians; 4. Bushmen; 5. Hottentots; 6. Negros of Soudan and Guinea; 7. Akkas; 8. Kafirs; 9. Nubas; 10. Pouls (Foulas or Fellatas); 11. Negritos; 12. Veddahs; 13. Dravidians; 14. Mundas (Kohls and Kolarians); 15. Indo-Chinese; 16. Siamese; 17. Birmese; 18. Himalayans, including Thibetans; 19. Annamites; 20. Cambodgans; 21. Chinese; 22. Japanese; 23. Ainos; 24. Hyperboreans; 25. Mongols; 26. Malays; 27. Polynesians; 28. Americans; 29. Caucasians, including Circassians, Georgians, etc.; 30. Berbers; 31. Semites; 32. Asiatic Aryans; 33. Occidentals or Indo-Europeans.

The author expressly states that his intention has been to devote much more space to the inferior than to the superior divisions of men, and to treat with detail only of those less known. As he allots only five pages out of the one hundred and fifty-six of the volume to the North-American Indians, he must consider them to be 'superior,' and well understood. But they are not apparently thoroughly understood by him. His enumeration, not only of tribes, but of the most important linguistic stocks, is imperfect and inaccurate. He is wildly at fault in many of his generalizations, some of which it seems proper to correct. The Indian is said to dwell in miserable huts made of poles united in a cone and covered with skin. It is true that the conical form of temporary lodges prevailed from obvious circumstances; but the material for covering was much more frequently of bark and mats than of skins; and the more permanent dwellings were of various styles and materials, in which neither poles nor skins appeared, and were often comfortable. The statement is distinctly made, that each family lived in its own particular hut or cabin. The rule is almost without exception, that, apart from the temporary lodges, all dwellings were adapted to the living-together of several families: in other words, they were communal. Furthermore, the error is repeated, that the Indians subsisted almost entirely on the products of the chase, supplemented only by such vegetables as were the spontaneous productions of nature, all cultivation of the earth being despised. The fact is, that every tribe east of the Mississippi and between the St. Lawrence and the Gulf of Mexico cultivated the soil sufficiently to derive an important part of its subsistence therefrom. In general it may be remarked of the author's statements regarding the North-American Indians, that, when true at all, they are true only of particular tribes, and are not of wide application. In this he has merely travelled in the path of other European writers who have regarded these people as of a single homogeneous race; whereas by the criteria of language, physical characteristics, environment, etc., used for other parts of the world, there would be as much propriety in his dividing the North-American stocks as in several of the other divisions above quoted. When, moreover, he lumps the Indians of North and South America together, he does little better and is less candid than the old geographers, who labelled a fancied line 'terra incognita.'

GAGE'S ELEMENTS OF PHYSICS.

A text-book of the elements of physics, for high schools and academies. By ALFRED P. GAGE, A.M. Boston, *Ginn, Heath, & Co.*, 1883. 10+414 p. 12°.

BECAUSE we find lightning explained as the thunder-bolts of Jove, forged by Vulcan, remembering that this was no poetical idea, but the actual belief of a simple folk; because the Indians explain the setting of the sun by saying that it has burrowed into the earth; because such gross explanations satisfy the mind not yet developed, — should we in our teaching, that our knowledge may appear the more complete, make use of such false fancies?

Many teachers find it of supposed advantage to make use of the atomic theory in explaining solution, expansion, or the fact of smell. This gives, it is true, a clear picture of a possible mechanism. But is there not a danger, when the slender grounds there are for proof of such suppositions are found out, that the student may turn away, feeling that the whole structure of physics is built upon such conceits?

There is the satisfaction of a clear picture, which can be understood and compared with more tangible phenomena. But is not this a loss, when obtained at the expense of bringing in a conception of matter for which there are reasons, but reasons of a nature which cannot be appreciated by the beginner?

This prominence of atoms is an old bugbear of elementary text-books. Yet our knowledge in regard to them only dates from ten or twenty years ago, or, as Thomson would have it, from the work of Caudey on the dispersion of light. To be sure, the word 'atom' may be found in many a metaphysical discussion; but how could such wranglers, switching at phantoms, be expected to hit so small a thing?

It would seem safer to leave the causes of the general properties of matter as entirely unknown. When the child asks what becomes

of the sugar when dissolved, say we do not know.

Beyond this fault, which is common, the book is of merit as giving many experiments with apparatus of easy make. There is at times a lack of exact knowledge displayed, as from one who has studied in the schoolroom and not in the physical laboratory. But with the young learner the work will, without doubt, prove fresh and instructive.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

ASTRONOMY.

Virtual change of the astronomical unit of time. — Mr. E. J. Stone has recently communicated to the Royal society an important paper on a virtual change of the astronomical unit of time, which has taken place in consequence of the difference between Bessel's expression for the sun's mean longitude and the corresponding formulae of Hansen and Leverrier. The investigation was primarily undertaken for the purpose of finding an explanation of the rapidly increasing discordance between the moon's place and that indicated by Hansen's lunar-tables; and, after a careful examination of a number of other hypotheses, Mr. Stone thinks he has found the cause as indicated above.

For the sun's mean longitude, —

Bessel gives $\odot = 280°46'36''.12 + 1{,}296{,}027''.6182\,t + 0''.00012218\,t^2$,
Hansen " $\odot = 280°46'43''.20 + 1{,}296{,}027''.6741\,t + 0''.00011069\,t^2$,
Leverrier " $\odot = 280°46'43''.51 + 1{,}296{,}027''.6784\,t + 0''.00011073\,t^2$,

in which t is reckoned, *as supposed*, in Julian years from Jan. 1, 1850, Paris mean noon. Now, the old observations which Hansen used in forming his lunar-tables, and in determining its constants, were reduced according to Bessel's formula. When we compare tables, thus formed, with observations in which the date of observation is referred to the sun's place by means of Leverrier's or Hansen's tables of the sun, just such a discordance must arise as if the length of the unit of time had altered; i.e., as if Bessel's Julian year were different from Leverrier's, which is now used in our ephemerides, having been adopted about 1864. Up to 1863, Hansen's lunar-tables were satisfactory: since then, the error of the moon's longitude has increased from $+0''.121$ to $+10''.265$.

Mr. Stone thinks this will also clear up some perplexing discrepancies in results as to the moon's secular acceleration. He points out that Hansen's tables "cannot safely be used in the discussion of ancient eclipses until the effects of this confusion of units of time have been cleared." [This abstract is made, not from the paper itself, which is not yet printed, but from an account given of it by Mr. Stone to the Royal astronomical society.] — (*The observ.*, May.) C. A. Y. [1014

MATHEMATICS.

Sub-invariants. — In the two instalments of his memoir which have thus far appeared, Prof. Sylvester enters upon a new development in the modern algebra; namely, the theory of semi-invariants regarded as belonging to a quantic of unlimited order, in which aspect he designates them as sub-invariants. An important distinction between regarding a semi-invariant as appertaining to a particular limited quantic and regarding it as a sub-invariant, is, that it may, while irreducible in the former character, be reducible in the latter. The new problem thus arises of determining the absolutely irreducible sub-invariants of any given degree and weight. In section I. a number of general theorems are established concerning sub-invariants appertaining to a single quantic, and to systems of quantics, all of unlimited order; and a method is indicated by which the author has succeeded in disproving the proposition that ground-forms and syzygants cannot coexist. Section II. contains tables of 'germs' for the quintic and sextic, the germ of a sub-invariant being the multiplier of the highest power of its last letter. Section III. is devoted to a systematization of the method of deducing the complete system of ground-forms of a quantic by direct algebraical operation from the simplest system of forms in terms of which any other form, multiplied by a power of the quantic, can be rationally and integrally expressed. The method is due to Prof. Cayley, and is easily applied to the cubic and the quartic; but, beyond these very simple cases, its application would be practically impossible without the aid of the methods now introduced by Prof. Sylvester. The application to the quintic is given *in extenso*. Section IV. treats of absolutely irreducible sub-invariants; the generating functions are obtained for absolutely irreducible sub-invariants of the first seven degrees; from the generating function for the seventh degree it is inferred that ground-forms and syzygants must necessarily coexist in the case of quantics of a sufficiently high order, which constitutes the disproof above referred to. This section is followed by an excursus on rational fractions and partitions. (See **1016**.) — (*Amer. journ. math.*, v. 1, 2.) F. F. [1015

Rational fractions and partitions. — In an excursus on this subject, Prof. Sylvester gives, in an improved and more complete form, the theory of simple denumeration first published by him in 1855. The object of the theory is to find an analytical expression for the general coefficient in the expansion of the generating function; but its cardinal theorem applies to the expansion of any rational fraction, and not only of such as arise in the theory of partitions or denumeration. — (*Amer. journ. math.*, v. 2.) F. F. [1016

PHYSICS.

Heat.

Radiation and absorption of rock-salt. — Herr C. Baur has made some observations on this subject. His results do not agree with those of Melloni and Magnus. Melloni considered that heat, radiated from rock-salt, was not absorbed by plates of rock-salt, any more than heat radiated from other substances. Magnus found that rock-salt plates absorbed heat radiated from rock-salt much more than that radiated from other substances. He believed that the radiation from perfectly pure rock-salt would be completely absorbed by a plate of the same substance, and that the apparent exceptions to this law were due to impurities in the radiating plate. Herr Baur concludes from his experiments that, 1. Rock-salt absorbs its own radiations better than those from

any other body; 2. The absorption increases as the difference of temperature between the radiating and absorbing plates decreases; 3. The absorption is probably complete when both plates are at the same temperature. Magnus' exceptions were probably not due to impurities, but to a difference of temperature of the two plates. — (*Ann. phys. chem.*, xix. 1.) C. B. P. [1017

Electricity.

Hall effect. — Dr. E. H. Hall finds that the values of the 'rotational coefficients' given by him at the York meeting of the British association for zinc, aluminum, copper, brass, and lead, are confirmed by later experiments. On trying the effect of change of temperature, only a negative result was obtained with gold; with iron, the increase was two-thirds of one per cent, with a rise of 1° C. The coefficient, with change in the strength of the field from 1,000 to 7,500 absolute units, seemed to increase; but, of this, Dr. Hall does not feel sufficient confidence to publish his results. The object of another experiment was to determine whether any part of the rotational effect could be made permanent. For this purpose, a thin piece of very hard steel spring was used as the plate. The direction of the equipotential lines was permanently changed by the action of the magnet. This change was in the same direction as the temporary effect due to the magnet's action, and perhaps equal to two per cent of this. — (*Amer. journ. sc.*, xxv. 215.) [1018

ENGINEERING.

The power of a steamship. — The Oregon, of the Guion line, is to be the most powerful and the fastest of the transatlantic passenger-steamers. Her displacement is about 11,000 tons. Her engines have three cylinders, and are of 13,000-horse power. The boilers contain 74 furnaces, consume about 300 tons of coal per day, evaporate 2,700 tons of water, require 6,000 tons of air to support the combustion, or a volume of nearly 175,000,000 cubic feet, and the power developed is sufficient to raise about 200,000 tons one foot high per minute. The ship will make 20 nautical miles (knots) per hour, against an estimated resistance of 94 tons, or twenty times the resistance overcome by the most powerful locomotive. The Atlantic will be crossed in six days in good weather. — (*Lond. engineer*, April.) R. H. T. [1019

The exhaust-steam injector. — Mr. L. J. Groves read a paper before the Institution of engineers and shipbuilders in Scotland, March 20, describing the exhaust-steam injector. It resembles the feed-water injector of Henri Giffard both in principle and in its general construction. It forces the feed-water into the boiler by the action of the exhaust-steam at nearly atmospheric pressure, at the same time heating considerably the water passing through the instrument. It differs from the usual forms of Giffard injector in having the 'mixing' or 'combining' nozzle split in such a manner that it lies open when the apparatus is not working, but closes up to form the standard form of nozzle when the instrument starts into operation. The steam-nozzle is much larger than that of the common instrument, and has a central spindle, of cone shape, to direct and concentrate the jet. The instrument starts automatically when the engine starts. It draws cold water, and forces it into a high-pressure boiler at a temperature of 190° F. (88° C.). On a locomotive it has forced feed-water into the boiler at a temperature of 277° F. (136° C.), against a steam pressure of ten atmospheres. — (*Trans. inst. eng. shipb. Scotland*, April.) R. H. T. [1020

CHEMISTRY.

(Organic.)

Action of hydrochloric acid on caffeine. — When caffeine is heated with fuming hydrochloric acid to 260° in a closed tube, E. Schmidt finds that it is completely decomposed: —

$$C_8H_{10}N_4O_2 + 6H_2O = 2CO_2 + 2NH_2CH_3 + NH_3 + CH_2O_2 + C_3H_7NO_2.$$

Caffeine prepared from theobromine proved to be identical in its chemical and physical properties with the natural base. The decomposition of theobromine, when heated with hydrochloric acid, is shown by Schmidt and Pressler to be represented by the equation, —

$$C_7H_8N_4O_2 + 6H_2O = 2CO_2 + NH_2CH_3 + 2NH_3 + C_3H_7NO_2 + CH_2O_2.$$

By oxidation with nitric acid, theobromine gave methylparabanic acid and methylamine, and caffeine gave dimethylparabanic acid and methylamine. In the preparation of theobromine from cacao, Schmidt found in the mother-liquors needle-shaped crystals which proved to be caffeine. The action of hydrochloric acid upon xanthine is shown by the equation, —

$$C_5H_4N_4O_2 + 6H_2O = 2CO_2 + 3NH_3 + C_2H_5NO_2 + CH_2O_2.$$

— (*Ann. chem.*, ccxvii. 270.) C. F. M. [1021

Relative reactive power of the halogens in mixed haloid ethers. — L. Henry observed that in chlorbromethylen (CH_2ClCH_2Br) the bromine atom was removed by potassic hydrate, sodic ethylate, potassic phenolate, potassic acetate, and potassic sulphocyanate. Argentic nitrate substituted the group NO_3 for the bromine atom, and a bromnitrate of silver $\left(Ag_2\begin{matrix}Br\\NO_3\end{matrix}\right)$ was precipitated in quantity corresponding to the amount of argentic nitrate taken. The author regards this fact as evidence of the formula $\begin{matrix}Ag-NO_3\\|\\Ag-NO_3\end{matrix}$ for the nitrate. When the latter reaction was tried on chloriodethylen, iodnitrate of silver was precipitated. By the action of nitric acid, the iodine atom was replaced by the group NO_3. In bromiodethylen, the iodine atom seemed to be much less reactive than in the presence of chlorine; and, in general, the difference in reactive power between chlorine and bromine was much greater than between bromine and iodine. — (*Comptes rendus*, xcvi. 1062, 1149.) C. F. M. [1022

METALLURGY.

A new refining process. — At a recent meeting of the Société de l'Industrie minérale, M. Thiollier communicated the details of a method of refining pig, and finished iron and steel, by the action of damp hydrogen. To assure himself that the well-known laboratory experiment may be carried out on a large scale, he has erected experimental works near Paris, having four furnaces with cast-iron retorts capable of treating about one ton at a time. The retorts are coated inside and out with a vitrifiable substance to prevent oxidation, and loss of gas through the pores of the metal. Hydrogen is introduced through small metal tubes; and, in order to prevent all danger of explosion, the air in the retort is displaced by carbonic-acid gas before the hydrogen is allowed to enter. After being annealed for a few hours in an atmosphere of hydrogen at a dark-red to cherry-red heat, malleable cast iron acquires all the properties of steel. Coarse steels may be changed into fine tool steel. On wrought iron the action is slower. The cost is esti-

mated at two francs per 100 kilos of poor-quality iron. — (*Iron*, April 6; *Eng. min. journ.*, March 31.) R. H. R. [1023

The working of blast-furnaces. — At a meeting of the Society of mechanical engineers, Jan. 25, Mr. Charles Cochrane read an elaborate paper on the working of blast-furnaces with special reference to the conditions under which the analysis of the escaping gases is of value. The object of the author is to establish the fact that all economy in fuel, consumed to make a ton of pig iron with any particular class or size of furnace, is governed by three conditions: 1. Temperature of air introduced; 2. Temperature of escaping gases; 3. The quantity of carbon which can be maintained in the condition of carbonic-acid gas after it has once been transformed to this degree of oxidation from the carbonic oxide produced in the hearth. The paper contains tables calculated for conditions varying from good to bad. Several illustrations of furnace-working are given, of which the No. 3 Ormsby furnace is one. The ratio of carbonic acid to carbonic oxide was 424. The temperature of the blast was 700° C.; of the escaping gases, 340° C. Carbon as coke, per ton of pig, was 21.98 cwt.; carbon in limestone flux, per ton of pig, was 1.50 cwt. By the tables it is shown, that, without the weight of carbon as a factor, there are six conditions of furnace-working indicated by the analysis of the gases; but, taking the carbon also into account, it is shown that the ideal furnace should have used but 16 cwt. of carbon per ton of pig: hence 5.98 cwt. of carbon have been reduced from carbonic acid to carbonic oxide. — (*Iron*, Feb. 2.) R. H. R. [1024

The Carvés coking system. — The ovens are long, high, narrow chambers of brick-work built side by side. The partition-walls contain horizontal flues as well as the floor of the ovens. No air is allowed to enter; and the only opening left during the heating is the pipe which carries the volatile products through condensation and absorption apparatus in order to save the tar and ammonia-water. The gas is conducted by the floor-flues to the small fire-grate at one end of the oven, and there burned; the products of combustion pass through the wall-flues, on their way to the stack; and, by this means, much heat is saved. There is no burning and consequent loss of the coal itself, as is the case in the beehive ovens; also the valuable by-products are saved. Tests show that the hardness of the coke increases as the width of the oven decreases. The cause of this is probably due to the quick and intense heating. The fixed carbon obtained in this way is about 75 per cent, while other methods give only 55 to 65 per cent. A battery of one hundred ovens will furnish steam for about 400 horse-power over and above the making of the coke and the rendering of the products. — (*Coal*, March 28.) R. H. R. [1025

Artificial fuel. — The process of Mr. E. F. Loiseau for making artificial fuel from coal-dust is in successful operation in Philadelphia, where from 80 to 300 tons, according to size of the lumps, are made daily.

The process of manufacture may be briefly outlined as follows: —

The coal-dust is fed into hoppers, together with about eight per cent of bituminous slack, from which it passes through a series of four cylindrical revolving drums, in which it is thoroughly dried. From these it is carried to a receptacle situated near the press. The dust, still at a temperature of about 140° F., is then thrown into the mixing apparatus, in which it is thoroughly stirred by revolving shafts with blades, while the proper quantity of pitch and coal-tar is added from a reservoir in which it is maintained at a temperature of 180° by steam-heat. The pitch is mixed with a certain quantity of coal-tar to give it the proper toughness. When thoroughly mixed with the melted pitch, the mass is plastic, and can readily be moulded into any desired shape. It is then carried to the press, where it is delivered between rolls having moulds upon their surfaces, from which the egg-shaped lumps are discharged. When discharged from the press, the lumps are quite hot, and have to be cooled by jets of water.

As thus prepared, the fuel is compact and very hard. Formerly clay was used as a cementing material, but now no incombustible or ash-producing material is required. The fuel is said to be even superior to the natural coal; and this opinion is borne out by an analysis which gave the following results: —

	Chestnut anthracite.	Loiseau fuel.
Carbon	73.40	82.01
Hydrogen	3.09	2.56
Moisture	0.44	2.41
Ash	17.95	10.47
Nitrogen and oxygen by difference	5.12	2.55
Theoretical calorific power, British thermal units	12,339.50	13,853.00
Equivalent to the evaporation, from and at 212°, of lbs. water	12.76 lbs.	14.33 lbs.

[1026

AGRICULTURE.

Earth-worms and fertility. — According to Hensen, earth-worms increase the fertility of the soil by forming burrows through which the roots of plants can descend into the subsoil. This applies chiefly to Lumbricus terrestris, while L. communis is confined chiefly or entirely to the surface-soil. The tap-roots of many plants, he thinks, may be able to force their own way through the hard subsoil; but the more slender side-roots descend chiefly through worm-burrows, or other channels, such as those left by old decayed roots. By excavating in frozen ground, he was able to trace roots downward through worm-burrows, and to observe that the layer of excrements with which the latter were lined was covered with a delicate network of root-hairs proceeding from the root in the interior. An important function of these roots Hensen believes to be, to supply the plant with water from the moist subsoil; and this is particularly important in the case of quick-growing annuals, like the cereals, which must develop their root-system rapidly, and frequently have to withstand prolonged dry weather. It is plain that no new material can be added to the soil by earth-worms; but they effect the fixation of vegetable matters in the soil by drawing into their burrows leaves, and other loose fragments of vegetation: they hasten their decomposition, and distribute them through the various layers of the soil. — (*Landw. jahrb.*, xi. 661.) H. P. A. [1027

GEOLOGY.

Lithology.

The Ardennes phyllites. — Extended chemical and microscopic examinations of the Ardennes phyllites by Renard show that they are composed of sericite, chloritoid, and either quartz or calcedony, with variable quantities of magnetite, hematite, pyrite, pyrrhotite, ottrelite, sillimanite, rutile, tourmaline, zircon, garnet, and carbonaceous material. Apatite was observed in one specimen. — (*Bull. mus. roy. Belg.*, i.) M. E. W. [1028

Archeological lithology. — Jannettaz and Michel from chemical and microscopic examination of two fragments of images obtained in Oaxaca, conclude that the rock is serpentine. Like examination of a pierced cylindrical bâton from Tetihuacan caused it to be regarded as a microcrystalline albite. The rocks were respectively colored greenish gray, deep green, and milk-white with a greenish tinge. — (*Bull. soc. min. France*, April, 1883.) M. E. W. [1029

Meteorites.

Fusion structures in meteorites. — The reviewer having expressed himself favorably (**24**) regarding an abstract of Wiechmann's paper, it becomes necessary, on examination of the completed form just published, to withdraw his commendation. The paper is a rambling, nearly worthless essay. So far as we can judge, the conclusions appear to be in the main correct; but they are mere guesses so far as this paper goes. The plates are coarse and unnatural. The only real evidence the article contains (which can be found on almost every page) shows the author to be destitute of the elements of the knowledge necessary for the work he has undertaken. — (*Ann. N. Y. acad. sc.*, ii. 289.) M. E. W. [1030

MINERALOGY.

Pachnolite and thomsenolite — Since the analyses of J. Brandl have shown these very similar minerals to have the compositions ($Al\ F_3$, $Ca\ F_2$, $Na\ F$) and ($Al\ F_3$, $Ca\ F_2$, $Na\ F$, H_2O) respectively, Des Cloizeaux has subjected the same to renewed optical and crystallographic examination. The crystals of pachnolite are always very small, and associated intimately with the thomsenolite. When heated in the closed tube, they decrepitate violently, giving no water. They are referred to the monoclinic system, with axial relation $c : b : a = 1.326676 : 1 : 0.859495$ $\beta = 89° 41'$. The thomsenolite is distinguished by its perfect basal cleavage. When heated in the closed tube it decrepitates violently, giving off acid water. The crystals are monoclinic, with the faces of the hemi-octahedron and prism striated parallel to their intersection with the base, and having the axial relation $c : b : a = 1.0883 : 1 : 0.998741$ $\beta = 89° 12'$.

These two minerals, which have been much confounded and united, are thus shown to be distinct, not alone in chemical, but also in physical and crystallographic properties. — (*Bull. soc. min.*, v. 317.) S. L. P. [1031

PHYSICAL GEOGRAPHY.

Ripple-marks. — The cause of the production of ripple-marks in marine sands, lately investigated by A. R. Hunt (*Proc. roy. soc.*, xxxiv. 1882, 1), has been further studied by C. de Candolle. He shows that they are caused by a horizontal oscillating or intermittent motion of the bottom-water, generally arising from the effect of wind on the surface, and makes it probable that they are produced at very considerable depths, and in directions independent of the surface-winds blowing. Such ripples are always formed on the surface of a viscous mass when a liquid moves back and forth, or intermittently forward, over it. Attention is called to the possibility that rippled cirrus clouds may have a similar origin, and to the resemblance between some artificial ripples and certain organic forms. Several well executed plates illustrate the paper. — (*Arch. sc. phys. nat.*, ix. 1883, 241.) W. M. D. [1032

Patagonia. — C. Martin calls attention to the contrast, dependent on the winds and consequent rain, between the country east and west of the southern Andes. North of lat. 40° S., where even the passes approach the height of Mont Blanc, this contrast is strongly marked; but farther south the cordillera is broken, and gives more open passage to the moist winds. At its eastern foot the numerous and large lakes are all fresh, having overflow during at least part of the year. Farther eastward the country becomes dry and barren, though nowhere being a desert of drifting sand. Its small lakes are saline. The Patagonian Andes, therefore, do not constitute a continuous range, but consist of a series of moderately high volcanoes on the ragged western border of the tableland, deeply cut by fiords and by rivers, that in some cases rise at a considerable distance from the Pacific coast, as found by the explorers, Cox, Fonck, and Musters. Forests extend as far north as lat. 35° S., but there they are found only on the mountain spurs. South of lat. 37° the lowlands also are forest covered, except where occasionally cleared by the Indians, who have, till lately, occupied this district to the exclusion of Spaniards and Chilians, and again between Valdivia and Osorno (lat. 40° to 42° S.), where opened by German colonists. The mainland and archipelago of the fiord region, where the Chilian hydrographer, Simpson, has counted over one thousand islands, are well wooded, the trees extending above the foot of the glaciers, up toward the snow-line. A brief description is given of the more important forest-trees. A peculiar building of lake-barriers is described (whether on sufficient observation or not does not appear) at several points in the southern fiords; for example, in the bay into which the glacier from the flank of San Valentino (3,870 met.) gives off its bergs, which, on melting, form a bar like a moraine, and in time enclose a part of the bay, which then becomes fresh by outward drainage. One such lake has already been formed here, and another is forming. — (*Mitth. erdk. Halle*, 1882, 88.) W. M. D. [1033

GEOGRAPHY.

(*Europe.*)

Surface and structure of Wurtemberg. — Beginning with a quotation from Murchison, — "No really good topography can be made by any surveyor who neglects geological data," — E. Hammer describes the close relation between the geological structure of Wurtemberg and the form of its eroded surface. Valleys cut in the *buntsandstein* have evenly rounded side-slopes; in the *muschelkalk* the slope begins abruptly at the line of a hard upper stratum, and sinks directly to the base; in the *keuper* the slope is broken by steps or terraces of harder and softer layers. Most of the larger streams follow the *muschelkalk*, and their upper courses meander so irregularly that the most ordinary topographic map reveals its presence. The forms of the successive lias, Jura, and tertiary deposits are given in detail. In upper Swabia, glacial deposits present their peculiar landscape of systemless hills and hollows, with drainage so imperfectly established that peat-swamps occupy a considerable part of the surface. The lack of illustrations decreases the value of this paper; but its method is excellent, and should find many followers. — (*Kettler's zeitschr. wiss. geogr.*, iii. 93, 148.) W. M. D. [1034

Area of Italy. — The official estimates of the area of Italy give a surface of 296,323 □ kil., according to figures established in 1864; but in the past year several statistical almanacs have changed this to 288,540 □ kil., according to the results of Gen. Strelbitsky (*Superficie de l'Europe*, 1882). Prof. G. Marinelli of the university of Padua does not ap-

prove of this change, as he regards the cartographic material on which the new estimate was made as of less than mediocre value. — (*Boll. soc. geogr. ital.*, vii. 1883, 241. Further discussion of the question is given in *Atti istit. venuto*, ix. 1883, 179, 295.) W. M. D. [1035

(*Asia.*)

Euphrates valley. — A corrected sketch-map of M. v. Thielmann's route from Kerbela, near the Euphrates, westward across the desert valley to Palmyra, is prepared by R. Kiepert. It shows the great barrenness of the adjacent flat country, slightly indented by dry stream-courses extending north-easterly to the river. Some of these are two hundred feet below the general surface, and sometimes contain pools and springs. — (*Zeitschr. f. erdk. Berlin*, xvii. 458.) W. M. D. [1036

Improvements in Persia. — Dr. J. E. Polak concludes his account of an expedition to the Karagan and Elvend regions in 1882 by noting the changes in the country since his earlier visit in 1860. In addition to the overland telegraph-line that connects India with Europe, there are several shorter lines across the country. The service is regular, and despatches can be sent in English and French as well as Persian. Many new roads have been constructed, and, although not to be compared with the smooth highways of Europe, they serve well for caravan traffic ; but roads are still lacking in many districts. A responsible postal-service is established, both for the interior and for foreign correspondence; and a uniform currency in gold and silver is introduced. With the improved means of communication, letters of credit can now take the place of a heavy supply of metallic money, that travellers formerly found necessary. Railroads are projected from the Caspian southward: they will have the advantage of finding coal and wood near their lines, but also the difficulties of heavy grades between the coast and the interior tableland, and a lack of good harbors at their termini. European methods are introduced in many civil and military arts, and a general tolerance of most sects and nationalities. Whether this improvement will continue or not is doubtful, as the present Shah is over fifty years old, and none of his sons give assurance of carrying on his reforms. — (*Mitth. geogr. ges. Wien*, xxvi. 1883, 106.) W. M. D. [1037

(*Pacific Ocean.*)

Polynesia. — An entertaining sketch of a three-years' voyage to many of the island-groups in the western Pacific is given by Dr. O. Finsch, who has lately returned to Europe with large collections. His studies were chiefly ethnological. Opportunity for such investigation is rapidly disappearing; for the local peculiarities of the natives on the various island-groups are fast fading away under the influence of traders and missionaries. Among the natives of the Marshall group, the making of large canoes from the trunks of breadfruit-trees is already a lost art. On one of the Caroline Islands, only about three hundred natives remain; and their earlier customs have largely disappeared with their conversion to christianity. In the Melanesian Islands there has been less change. The natives go naked, and retain their cannibal fashions; and, by the absence of certain peculiarities not at all flattering to our civilization, the lack of European influence is further proved. Herr Finsch found the atolls monotonous. "They are like American hotels: in knowing one, you know them all." The higher islands have much more interest. The irregularity of communication between the different islands makes travel very difficult. One must wait for accidental opportunities. With a little schooner of twenty tons, and a native crew of six or seven men, much more could be done. — (*Verh. erdk. Berl.*, 1882, 553.) W. M. D. [1038

Philippine Islands. — Dr. S. Kneeland regards this group, with many others south-east of Asia, as the remains of a sunken continent, finding evidence for this view in their broken outline, in the distribution of races and their monuments, and in the numerous volcanoes on the fracture along the border of the lost land ; but this latter point is certainly open to question, as is his opinion concerning the finished condition of the earth, and the office of volcanoes as safety-valves to earthquakes. Volcanic and seismic phenomena are very marked on these islands. The symmetrical cone of Mayou gave forth a continuous stream of lava from its very summit for the last five months of 1881, and, in earlier years, has done great damage to the villages on its flanks. The ruins of the old town of Daraga, on the south-east, may still be seen partly covered by the lava of 1814. Majayjay or Banajao, now dormant, formerly contained a lake that was destroyed in the eruption of 1730. 'Large stones thrown from it are scattered far and wide beyond its lava-flows.' From the lake of Bonbon, seventy miles in circumference, rises the cinder-cone of Taal, twelve hundred feet high, with a ragged crater six miles around, within which is a sulphurous lake giving forth suffocating fumes. The effect of earthquakes is seen in the change from heavy stone to light wooden buildings of Spanish construction. The most violent recent shocks at Manila were in 1863 and 1880. A meteorological observatory in charge of the Jesuits publishes a daily weather bulletin ; January and February have the coolest weather, with dry north winds; April and May are hottest; and August and September have the heaviest rains. Having an extent from north to south over several degrees of latitude, and a strongly broken surface, the islands enjoy a remarkable variety of climate, and the pine and maize flourish as well as the palm and orange. The author's chief attention was given to ethnographic questions, and some of his results have already appeared in SCIENCE. — (*Bull. Amer. geogr. soc.*, 1883, no. 2.) W. M. D. [1039

BOTANY.

Flowers of Turneraceae. — From studies by Urban, it appears, that, of the eighty-three species, fourteen are certainly homogone, and five probably so, while forty-eight are dimorphic, and eight probably so. Six species are incompletely dimorphic; one has six varieties homogone and six heterogone, and one is unknown, with respect to the length of the essential organs. Mathurina penduliflora, Piriqueta capensis, Berneriana madagascariensis and odorata, which depart most from the other Turneraceae, and are remarkable for their geographical distribution, are homogone. Aside from these, the homogone species are represented in all genera, and in most of the smaller groups of naturally related species, and they are distributed as widely as the order.

When a single individual of a species, found homogone in many specimens from different localities, shows an inclination to heterogony, this manifests itself in the increased length of the style, while the stamens retain their usual length. The northernmost variety of Turnera ulmifolia is represented only by the long-styled form. Certain species are characterized as incompletely dimorphic. The long-styled form is as it should be, while in the short-styled flowers the branches of the stigma nearly or quite reach the anthers. In these self-fertilization can

occur if insect visits fail. These are found only in groups where specific distinctions are not well marked.

In completely heterogone species, the differentiation extends only to the relative length of stamens and pistil, or it may include the direction of the short styles, which diverge so much as to bring the stigmas in contact with the perianth, or even the length of the stigmatic rays and the form and pubescence of the style. The colors of the flowers do not stand in any relation with the monomorphism or dimorphism. Dimorphic species have more conspicuous flowers than their nearest homogone relatives, this depending either on the size of the individual flowers or on their grouping in compact clusters. The duration of the several species shows a remarkable connection with the presence or absence of heterogony. The large-flowered, dimorphic species are perennials, while most of the small-flowered, homogone species are annuals. — (*Berichte deutsch. bot. gesellsch.*, 1883, heft 2.) W. T. [1040

Floral evolution in monkshood. — Grant Allen gives a popular account of the flower of Aconitum, contrasting it with a buttercup, and showing how symmetry and regularity have been lost, and its blue color acquired, through the advantage derived from the visits of bees favored by these changes. The bilateral structure, and the suppression of the lower three petals, are connected with the lateral position of the flowers on the axis of inflorescence; while the reduction in the number of carpels, and the increase in the ovules, secure the production of as much seed from a single visit of a bee as the buttercup secures from numerous visits of the mixed group of insects to which it is open. The differences in the relative position of the essential organs during anthesis would also have proved very interesting in this connection. — (*Knowledge; Pop. sc. monthly*, May.) W. T. [1041

The relation of the tension of the bark to the formation of annual rings in wood. — It is stated in several text-books, that, owing to the slighter pressure exerted by the bark in the spring, wider wood-cells are produced than at a later period, when the pressure is considerably augmented. Experiments by De Vries certainly can be interpreted in this way. Krabbe has recently investigated the subject in a somewhat different manner, and has arrived at a different conclusion. It cannot be said that the subject has yet been settled. It offers a promising field for further work.

Krabbe's method is the following: strips of bark, not as yet covered with cork, are carefully cut from the stem, and the amount of force required to restore them to their original breadth determined exactly by means of weights. It is well known that such strips of bark shrink at once, and that a considerable force is needed to bring them back to their former size. The tangential tension of the bark increases with the growth of the stem up to the time when the corky layer is formed, unless some injury influences the phenomenon. But if we look at the radial pressure (reckoned as the quotient of the tangential tension divided by the radius), it is found that this diminishes with increase of the stem in thickness. Furthermore, the radial pressure in autumn is about that of spring, never differing from it more than one gram in the square millimetre; hence being, as Krabbe thinks, too slight to account for the difference between the spring and autumnal wood. He explains the increase of growth, when pressure is removed by taking off the bark, by the pathological activity following wounds. — (*Sitzungsb. akad. wiss. Berl.*, Dec. 14, 1882.) G. L. G. [1042

ZOÖLOGY.

(General paleontology.)

Jurassic of Galicia. — In volume v. of the memoirs of the academy of sciences of Cracovia, Dr. Alth, under the title of the 'Limestone of Nizniow, and its fossils,' describes the recently discovered and very important beds of that locality. From the character of the fossils he refers them to the upper white Jurassic, answering to the united strata of the Kimmeridge and Portland. This work is important as showing the existence of the Jurassic in eastern Galicia, where it was formerly unknown, and of great paleontological importance as describing 179 species of fossils, of which 124 are new. Of these, 5 are annelids, 93 gastropods, 57 acephalans, 5 brachiopods, 2 echinoderms, 6 corals, 6 rhizopods, and 4 plants. Curiously, only one cephalopod has been found, the Nautilus Geinitzi. — (*Bull. soc. geol. France*, Jan., 1883.) J. B. M. [1043

The sigillarian stumps of Nova Scotia. — One of the most interesting results of the later visits of Sir Charles Lyell to this country was his discovery, in company with Dr. Dawson of Montreal, of a number of animals entombed in stumps of sigillarians in the coal-measures of Nova Scotia. Dr. Dawson has recently renewed his explorations in the field by aid of a grant from the Royal society of London, and his conclusions have just been published. Up to 1876, only three additional trees, of those which became accessible by the wasting of the beds, furnished animal remains. But by cutting and blasting, twenty others have now been examined, ten of them proving productive. Dr. Dawson finds that "the circumstances of the growth and entombment of this forest entirely contradict those theories as to Sigillaria and Stigmaria which suppose that these plants grew in water, or on submerged areas. . . . The surface on which the trees grew . . . must have been underlain by several feet of peaty matter." The number of terrestrial batrachians found in the stumps has been doubled by these investigations, additional species of Hylonomus and Hylerpeton having been found, and Fritschia and Sparodus added to the genera, besides a new form called Amblyodon, represented imperfectly by a few teeth and bones, — making, in all, seven genera and twelve species. Of land-snails, besides Zonites priscus, and Pupa vetusta, found before, another species of Pupa, called P. Bigsbii, has occurred. Of articulates, S. H. Scudder reports two more (unnamed) species of Archiulus, bringing the number of myriapods to six, and fragments of scorpions — not before recognized — probably belonging to two species. A half a dozen plates illustrate the batrachian remains. A note is added on the footprints of batrachians observed in carboniferous rocks of Nova Scotia, which are referred to six species, equally divided between Sauropus and Hylopus. — (*Phil. trans. roy. soc. Lond.*, 1882, 621.) [1044

Mollusks.

Variations in Unionidae. — Rev. W. C. Hey contributes a suggestive paper on the variations observed by him in Anodonta and Unio in the waters of the Ouse and the Foss, and the canals communicating with them, within a very limited area. The point of it is, that, apparently, very slight changes in the environment produce important changes of appearance in the mollusks referred to; though why such causes should produce such effects is not by any means clear. — (*Quart. journ. conch.*, 1882.) W. H. D. [1045

Action of the heart during hibernation. — C. Ashton has studied the action of the heart in hibernating helices. The observation is difficult owing to the opacity of the parts and the necessity of guarding against the temperature radiating from the observer's body. The pulse seems to be irregular, or rather, perhaps, to pass through active and quiescent cycles. Absolute inactivity of the heart probably does not occur during hibernation. Under scrutiny, the pulsations varied from three to twenty-two per minute. The animal is extremely susceptible to changes of temperature, as a touch of the finger will often double the rate of pulsation, which also rises with exercise or motion. — (*Quart. journ. conch.*, 1882.) W. H. D. [1046

Malacological notes. — Dr. W. Kobelt proposes to issue through Theodor Fischer, in Kassel, an iconography of European shell-bearing marine mollusks, which is much needed, and will be extremely useful to malacologists. It is to contain anatomical as well as conchological details, and will be issued in parts containing four plates each, in a colored and an uncolored edition, at the rate of a volume annually. —— Dredgings by Admiral Spratt in the Black Sea have been examined by Dr. Jeffreys, who finds them to contain six species of shells, hitherto unrecorded, from that basin, one of which (Trophon breviatus) appears to be peculiar. He regards the Black Sea zoölogically to be a mere offshoot of the Mediterranean, as the latter is of the North Atlantic. —— Bergh has printed in the *mittheilungen* of the zoölogical station at Naples a contribution toward a monograph of the nudibranchiate genus Marionia of Vayssière, — a group belonging to the Tritonlidae, and of which a few species are known in the Mediterranean and Red Seas. The paper is illustrated by a beautiful colored plate. — W. H. D. [1047

VERTEBRATES.

The heart as a suction-pump. — It has long been discussed whether the ventricle of the heart is not only a force-pump in systole, but also a suction-pump in diastole, actively dilating, and drawing blood into it from the veins. That within the closed thorax there is, due to the negative pressure prevailing in that cavity, an active diastole cannot be doubted; but is there such a diastole when the chest is opened, or does then the blood returned to the heart from the veins merely push apart the flaccid walls of the heart-chambers?

Goltz and Gaule have, among others, maintained the doctrine of such active diastole. Even with an open thorax, they found a negative pressure occurred in the heart during some part of a cardiac period · and, though their method of work did not enable them to determine at what moment in the heart's cycle this negative pressure occurred, they assumed that it was during the diastole. Moens, however, in a subsequent noteworthy paper, brought forward experimental and other proofs that the negative pressure in the left ventricle occurred at the end of the systole, and not in the diastole at all: if so, the heart was not a suction-pump. Jager now returns to the question; and taking as starting-points the assumptions, that, if negative ventricular pressure occurred at the close of the systole it must show itself in the aorta, but if during diastole in the auricles, he concludes that it is diastolic; since his experiments show that at no time is there a negative pressure in the aorta, while there may be such in either auricle. Accordingly, he maintains that the heart is a suction-pump. We may remark, however, that the correctness of his primary assumption is by no means certain: hence his whole argument falls to pieces. There is, on the contrary, strong reason to believe that the ventricular contraction lasts after closure of the semilunar valves, and that it is just at this very end of the systole that the negative intracardiac pressure occurs. — (*Pflüg. archiv*, xxx. 491.) H. N. M. [1048

'Mastzellen' of connective tissue. — The granular cells described in 1877 by Ehrlich, and since known by the name of 'mastzellen,' have been studied by Raudnitz. Their frequency in different organs and animals is very variable. They are generally abundant in the tongue, but are rare or wanting in the human tongue, and could not be found in any part of the rabbit. They are wanting in embryos, and are few in young animals. Raudnitz supposes that they are cells undergoing mucous degeneration. — (*Arch. mikr. anat.*, xxii. 228.) C. S. M. [1049

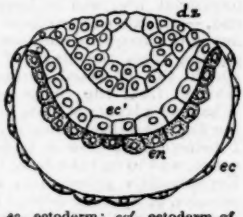
Haematoblasts of Hayem. — These little granular masses, which were first accurately described by Max Schultze (1865), have since been frequently observed; but their meaning and history have not been hitherto satisfactorily determined. Hayem believed them to be red blood-globules in process of development, and accordingly named them haematoblasts. Bizzozero has studied these bodies, which are about one-half the diameter of the red globules, in the circulation of living mammalia as well as in extravasated blood. In the latter they change with extreme rapidity, and each one becomes a centre from which the filaments of fibrine radiate, upon coagulation. When unaltered, these little disks are colorless, and bounded by nearly parallel surfaces. They have no nucleus, and contain two optically distinct substances, and exhibit with various reagents essentially the usual changes of protoplasmic bodies. Bizzozero denies that they change into red blood-corpuscles, as maintained by Hayem. The bulk of the memoir deals with the relation of these bodies to thrombosis and coagulation. The closing section is devoted to an account of these plates in cold-blooded animals. [Are not these bodies products of degeneration, perhaps amyloid?] — (*Virchow's arch.*, Nov., 1882. *Résumé* in *Arch. ital. biol.*, ii. iii.) C. S. M. [1050

The origin of apnoea. — In his third contribution, Knoll discusses the origin of apnoea. When rabbits in which the vagi are intact are made apnoeic by free artificial respiration, spontaneous respirations again appear only after the blood has become sufficiently venous to stimulate the vaso-constrictor, cardio-inhibitory, and other centres in the medulla. This depression of the irritability of the breathing-centre is so great, that, even when the blood-flow to the brain is cut off, no breathing-movements are called forth, although the vaso-constrictor centre becomes powerfully stimulated. This is in opposition to the results obtained by Rosenthal. The difference between his and Rosenthal's results may be owing, he thinks, to the latter having experimented upon animals with the chest opened. Although the respiratory centre in the apnoeic animal does not respond to stimuli from the blood, yet reflex stimulation, electrical or mechanical stimulation of the vagus or of the nasal mucous membrane, for instance, can still produce inspiratory contractions; not so readily, however, as in an animal not apnoeic. The production of apnoea in artificial respiration he attributes, in part at least, to a rhythmic stimulation of the vagi. In rabbits in which both vagi were cut, he succeeded in bringing about apnoea by artificial respiration only in five cases out of twenty; and in three of these there was evidence of diminished irritability of the respiratory centre from other causes. In the other cases a flattening of the respiratory curve could be perceived, —

a condition which he calls 'relative apnoea.' To obtain 'absolute apnoea,' one vagus at least must be intact. Moreover, when, by a special apparatus, the central end of the divided vagus was stimulated by a constant current at each artificial inflation, 'absolute apnoea' could in most cases be produced; although in the same animal, without corresponding stimulation of the vagus, only 'relative apnoea' was the result of artificial respiration. That this rhythmic stimulation of the vagus is only one of the factors in the production of apnoea is shown by the fact that artificial stimulation alone does not cause apnoea; while, with the vagi cut, artificial respiration alone will bring about a partial or relative apnoea, indicating a diminished irritability of the respiratory centre. — (*Wiener sitzungsb.*, lxxxvi. iii. 101.) W. H. H. [1051

Mammals.

Early development of rodents. — In a very important and interesting contribution to this subject, Kupffer describes the following discoveries from observations of the ova of the field-mouse, made upon sections through the uterus and egg *in situ*. The ovum of Arvicola forms a normal vesicle. In the germinal area lie the ectoderm and entoderm in the usual manner. The ectoderm consists, as in rabbits, of a 'deckschicht' (Rauber, *Sitzungsb. naturf. ges. Leipzig*, 1875) of thin cells, and a main layer of cubical cells, which alone enter into the formation of the embryo. The 'deckschicht' is temporary in the rabbit; but in the field-mouse it is the seat of a rapid and early proliferation, which leads to the formation of a knob of cells, which, on the one hand, is attached to the uterine-wall, and, on the other, forces in the germinal area, both ectoderm and entoderm. From the germinal area thus invaginated, into the interior of the ovum, the embryo is developed according to the typical method in mammalia. The mass of mesoderm-cells marking the primitive streak, and the position of the future allantois, appear at one end. The amnion folds are developed in front and behind from the inner ectodermal layer, and therefore inside the 'deckzellen.' The invagination of the germinal area goes so far that the whole egg is elongated in that direction, until it acquires a cylindrical form. It is thus evident, that although the ectoderm occupies, as a result of the invagination, a central position, yet morphologically it always remains strictly the outside layer. — (*Sitzungsb. akad. wiss. München*, 1882, 621.) C. S. M. [1052



ec, ectoderm; *ec'*, ectoderm of germinal area; *en*, entoderm; *dz*, 'deckzellen.'

Embryology of rodents. — Paladino gives the following *résumé* of his results; and, as they have a slight priority of publication over recent German papers (ante **849-851**), they deserve especial attention. The whole cylinder formed during the first developmental stages of certain rodents is the embryo, and it is implanted on the decidual new formation by the caudal extremity. This is proved especially by the fact that it is this part from which the allantois arises. The cylinder, and the vascular portion of the decidual new formation, are continuous, and so remain throughout gestation by means of the vessels falsely called omphaloid. The decidua forms not only the placenta, but also the first envelope around the embryo, — the chorion, falsely so called. (This is in direct contradiction to the latest opinions of Hensen.) Between the embryo and the decidua is a large space, filled at first with blood, which Paladino thinks is probably produced by the metamorphosis of the granulosa cells discharged from the Graafian follicle along with the ovum (!). — (*Arch. ital. biol.*, ii. 363.) C. S. M. [1053

Germinal layers not homologous. — Repiachoff, whose singular hypothesis concerning the mammalian ovum was reported (**627**), has advanced the still more remarkable opinion that the germinal layers in vertebrates are not homologous primitive organs, and maintains that the same organ may arise in different animals from different layers. (This is directly opposed, especially as regards the notochord and the mesoderm, to which Repiachoff refers as illustrations, by the best recent investigations, and, indeed, the whole theory seems to the reporter without foundation.) — (*Zool. anz.*, vi. 148.) C. S. M. [1054

ANTHROPOLOGY.

Tylor's lecture at Oxford. — On Feb. 15 and 21, Prof. E. B. Tylor lectured at the University museum, Oxford, upon anthropology. The occasion was the instalment of a museum of civilization, the nucleus of which is the Pitt-Rivers collection, previously mentioned in SCIENCE. The speaker first drew attention to the fact that the theory of development has had its own evolution parallel with the progress of knowledge. Pritchard recognized the descent of mankind from one pair, whom he considered to have been negroes; and as we have been able to reconstruct the ancestry of the horse, Huxley leads us to hope that we may some day discover the fossil pedigree of his rider.

Mr. Tylor next spoke of the approach which craniоscopy is making to an exact science, drawing his illustrations from the crania of the British barrows, and other localities of undisturbed population. Comparative philology, properly understood, may tell its story in perfect accordance with anatomy. The blended parentage of the Fijians is heard in their speech, as it is seen in their faces. The cross-section of a single hair, examined microscopically by Pruner's method, shows it circular, or oval, or reniform; its follicle curvature may be estimated by the average diameter of the curls, as proposed by Moseley; its coloring-matter may be estimated by Sorby's method. This examination enables one to judge in what division of the human species to classify its owner. Climate, albinism, 'Addison's disease,' and other natural causes in their relation to race-color, are carefully considered.

It is upon the evolution of civilization, however, that Mr. Tylor is most happy, a subject to which he has devoted the most of his life. The last portion of the addresses, therefore, is devoted to the unfolding of several phases of social life in their relation to race and history. — (*Nature*, May 3.) [1055

The Trenton gravels. — Dr. C. C. Abbott has been observing closely the removal of gravel from the drifts of the Delaware near Trenton by railroad excavations, and has discovered new evidences of the existence of paleolithic man. The removal of the material reveals the fact that the beds were deposited at different times, masses of bowlders being overlaid by masses of sand, one of which, averaging a foot in depth, and extending nearly three hundred yards along the exposure, yielded not only the typical paleolithic implement, but four chipped stones of less definite shape, all of argillite. These objects were overcapped by a deposit nearly seven feet in

thickness, undisturbed, and containing several bowlders of large size.

Further research in the deposit, especially after a very severe storm, brought to light other rude implements which seem to be very old, and a human wisdom tooth. Dr. Abbott reviews also the discussion respecting the age and geological relation of the beds. — (*Proc. Bost. soc. nat. hist.*, xxii.) J. W. P. [1056

Nago language and proverbs. — Under the title of '*Les noirs peints par eux-mêmes*' (Paris, 1883), the Abbé Bouche, late missionary on the Slave Coast, presents an interesting pamphlet containing a large number of proverbs in the Nago language, with both literal and liberal translations and explanatory remarks. The proverbs show much of the customs and modes of thought of the people and give a favorable view of their intelligence. They are, however, in large part extracted from the 'Vocabulary of the Yoruba language,' by Samuel Crowther, a native Nago, afterwards bishop of the Anglican church, though the Abbé Bouche claims to have made important emendations in the linguistic part of the work.

This pamphlet is the first publication of *L'oeuvre de Saint Jérome*, which was lately instituted to furnish mission-schools with 'classical works in the language of the natives,' or, in other words, to facilitate the study of the several languages in current texts of those languages, not to rely upon forcing a translation of religious works into the foreign tongue, which in many cases does not contain the words necessary to express the ideas connected with the Christian religion. This new departure in the right direction, by missionaries, is the mode employed by the Bureau of ethnology of the Smithsonian institution, and its general adoption will prove of the highest philologic value. — J. W. P. [1057

Chuckchis and Chuckchi-land. — An unsigned article on the Chuckchi describes their distribution, migrations, mode of life; the habits of the bands who live by herding reindeer, by trade between the American Innuit and the Russians on the Anui and Anadyr rivers, or by coast-fisheries; the care and diseases of the deer; the fishing population of eastern Siberia, and the fish they catch; and the initiation, purposes, and results of the Maidel-Neumann expedition to Chuckchi-land. The harmonious relations between the Russians and reindeer-Chuckchis now existing, and the manner in which they were brought about, are clearly stated. There is little new ethnological matter in the article, but a good deal of useful and interesting historical material, while the rest has been brought up to date. — (*Deutsche geogr. bl.*, vi. ii.) W. H. D. [1058

EGYPTOLOGY.

Book of the dead. — The editing of a critical edition of the Book of the dead was, by resolution of the International congress of orientalists held at London, committed to the hands of M. Edouard Naville. The work is now done, and is to be published under the direction of the academy of Berlin. It has been edited from the papyri of the seventeenth to twentieth dynasties. There is but little before that period to contribute to this edition; and, after that period, the acquaintance with the hieroglyphs of the Book of the dead was lost, and the chapters were written in the hieratic characters. The scribes copied mechanically, without understanding the signs they traced; and so the papyri in hieroglyphs, after the twentieth dynasty, are filled with errors. The most important papyri, which have been made the base of the present work, are those of London (9,900 and 9,964), of Paris (III. 1, III. 85, III. 93), and that of Mesemneter. These are all texts of the eighteenth dynasty. Almost all the chapters of the Book of the dead, as published by Lepsius, have been found elsewhere, and forty-three chapters, hitherto unedited, have been added. The first volume will contain the text and all the variants of the vignettes, which often differ from those published by Lepsius. The second volume will contain the variants of the text. While the title, 'Book of the dead,' has been retained, Naville calls attention to the special name of the book in Egyptian, '*per em hrou*,' and says, "I believe that it means 'departure from the day' ('*sortie du jour*'); that is, departure from his day. The Book of the dead contains expressions like the following: 'I have been delivered from the evil of those who are in their days,' or again, 'I have not blasphemed the King during his day,' where the variants are, 'during the continuance of his life.' To leave his day is not really to lose life or existence (life continues beyond the tomb), it is merely to be delivered from the period set for every terrestrial life, and to have neither beginning nor end, — an existence without limits in time or space: hence the frequent addition to the expression, 'departure from the day,' of 'under all the forms which the deceased wishes'; that is, to become released from the limits of time and space. . . . Whatever advantage there might have been in taking the Egyptian title, though imperfectly translated, yet I believe that now it is better not to break with usage, and to call the book 'Book of the dead' until Egyptologists agree upon a translation of the expression of '*per em hrou*;' for which I propose 'departure from the day or from his day.'" — (*Revue egyptol.*, iv.) H. O. [1059

EARLY INSTITUTIONS.

Land-system of the Franks. — H. Hahn sums up the conclusions of Dr. Schröder in his book entitled '*Die Franken und ihr recht*.' He tells us how the writer takes a position opposed to that of von Inama-Sternegg, whose *Wirthschaftsgeschichte* we read with so much satisfaction a few years ago (1879). According to this new view, the freemen were distributed in strictly communistic village communities (dörfer mit strenger flurgemeinschaft), under the over-lordship (obereigenthum) of the kings. This, we are told, was the condition of things as late as the sixth century. After that time, the system of isolated farmsteads with private estates (einzelhof-system) was introduced very generally. According to von Inama-Sternegg, as the reader will remember, the einzelhof-system was the primitive system. We are quite at a loss to imagine upon what grounds this new theory can rest. It seemed to us that that of von Inama-Sternegg was well established by the testimony of the early records. We wonder, for example, how Dr. Schröder reconciles his theory with the statement of Tacitus in Germania 16: 'Colunt discreti ac diversi,' and with that other statement (Germ. 25), that the freemen had slaves set out upon the land like Roman coloni. We wonder, too, how he explains the references to private property in arable meadow, and even forest-land, in Lex salica, xxvii. And what did the freemen do with their slaves, if they lived in communistically organized villages? Slaves are mentioned in at least nine sections of the Lex salica. Then, we remember all the early formulae and documents in which landed property is described. How can Dr. Schröder do away with all this testimony? We must not, however, attempt to discuss, still less must we criticise, an argument of which we have seen only a very brief report. — (*Mitt. hist. litt.*, 1882, heft 3.) D. W. R. [1060

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

STATE INSTITUTIONS.

Ohio meteorological bureau, Columbus.

Weather report for April. — The mean barometric height for the month of April, which was 30.009 inches for the state, was lower than any mean yet reported from this bureau. The maximum of 30.382 inches is also lower than that of any previous report. A lower minimum was reported for both January and March; so that the range is not so great as in previous months, being, in fact, less than any before given. The reports show no unusual atmospheric disturbance during the month.

In temperature the month was remarkable for the high point reached in many localities. The mean for the month, 48°.1, is above that of any other month included in the reports. A maximum as high as 90° was reached at Oberlin on the 14th; and the minimum for the state, which was 15°, was recorded at the same station on the 3d. Thus the thermometric range for the state, 75°, is reported from one station. This range is less, however, than any before published. The mean daily range, which was 21°.5, was somewhat greater than that for previous months. The station at the State university, which in January reported the minimum daily range, returns the maximum for this month, it being 42°.8. The minimum daily range is reported from Wooster, at which station the most uniform temperature for twenty-four hours has been recorded for three months in succession. Notwithstanding the unusually high temperature on certain days of the month, on the whole it was slightly colder than the normal mean for April, which is about 50°.

In the amount of precipitation, the month fell somewhat below the average for April, which is about 3.5 inches. The average number of days on which rain or snow fell was almost exactly the same as in March, but the mean depth of fall was considerably greater. It will be remembered that the rainfall during February was largely in excess of the normal amount; and it will be noticed, that, since that month, less than the usual amount has fallen.

The prevailing direction of the wind during the month was from the south-west; and thunder-storms are reported as occurring on the 4th, 5th, 9th, 11th, 13th, 19th, 27th, and 28th.

PUBLIC AND PRIVATE INSTITUTIONS.

Museum of comparative zoology, Cambridge, Mass.

Recent additions. — The latest additions to the exhibition-rooms have been important, among them a fine skeleton of a fin-back whale, measuring over fifty-three feet in length. This skeleton, mounted by Ward, is suspended from the ceiling of the room devoted to mammals. The four skeletons of Moas, purchased for the museum at the Melbourne exhibition, have also arrived. They represent three genera and four species, and are probably, with the exception of those of the museum at Christchurch in New Zealand, the finest specimens discovered by Dr. Haast. The skeleton of Dinornis maximus measures over nine feet in height. It has been placed temporarily in the African room till a proper case can be built for it in the bird-room.

The series of anthropoid apes purchased from Ward — the orang, chimpanzee, and gorilla — have also been placed on exhibition. The African, Indo-Asiatic, as well as the Australian faunal rooms are now open to the public, although there are yet many blank spaces to be occupied.

The zoölogical collection is now so far arranged that the public can fairly estimate the advantages of the present distribution of limited exhibitions in comparatively small rooms devoted to special objects, as compared with the usual museum arrangement by which all the collections of an establishment are thrown open to visitors, without any attempt to select the more important or interesting objects, or to arrange them in an instructive manner.

As soon as the new geological and biological laboratories of the corner-piece are occupied, probably at the commencement of the next academic year, the same arrangement will be extended to the geological and paleontological collections.

The stalked crinoids of the Blake expedition. — The preliminary report of Mr. P. H. Carpenter on the stalked crinoids of the Blake (*Bull. mus. comp. zoöl.*, x. iv.) shows how greatly our knowledge of these animals has been increased by the recent dredging-expeditions. Not many years ago the specimens of Pentacrinus preserved in all the museums of the world could not have exceeded six or seven. Recently a few more specimens of a second species were collected at the Barbadoes; and the late Sir Wyville Thomson and Dr. William B. Carpenter had begun, with the help of this material, an extensive memoir intended to supplement the paper on Pentacrinus by Johannes Müller. But since the discovery of Rhizocrinus by the younger Sars, a number of genera and species of stalked crinoids have been dredged by the Norwegian, English, and American deep-sea explorers. With the exception of Rhizocrinus, however, none of the species were found in sufficient numbers to enable zoölogists to study them by the modern methods. Fortunately the Blake brought back from the Caribbean Sea two species of Pentacrinus in great numbers, a good supply of Rhizocrinus, and a couple of Holopus, all of which were placed by Mr. Agassiz in the hands of the late Sir Wyville Thomson for study. Since his death, all this material collected by the Blake has been transferred to Mr. Carpenter, who will incorporate his results in the final report he is preparing on the same subject for the Challenger expedition.

We may thus expect, judging from the excellent work done by Mr. Carpenter among the crinoids, an exhaustive memoir on this ancient group of crinoids, based upon ample material. Thus far, however, the study of the soft parts does not seem to have been so fruitful of interesting results as had been anticipated.

NOTES AND NEWS.

The signal-service under Gen. Hazen has issued a bulletin containing several reports, of which the first is that of Mr. W. M. Beebe on the relief expedition of 1882 to Lady Franklin Bay. This, as is well known, failed in its object, owing to adverse conditions of ice, etc. The second report, by Lieut. J. S. Powell, is on the relief expedition to Point Barrow for the purpose of replenishing provisions, and replacing any disabled members of the party. The attempt was also made to determine the astronomical position of the station at Uglaämie, near Point Barrow.

Lieut. Powell's narrative is lively and entertaining, containing numerous notes on the climate, people, and characteristics of the region he visited. The work of the station was going on in a manner believed to be satisfactory. Over 90,000 magnetic observations had been made from December, 1881, to August, 1882, by Messrs. Murdoch and Smith, and coincident meteorological observations carried on. Under the supervision of Lieut. Ray, in command of the party, daily exercise had been enforced, and other precautions taken for the health of the party, which had continued good, though it was thought best to replace two of them by new men. The determinations of position and chronometer rates are presented in a voluminous appendix by Mr. Winslow Upton of the signal-service; but owing to bad weather and other causes they were so unsatisfactory as to be worthless, and might better have been omitted. Precautions have been taken to secure better results this season. The third report is that of Lieut. Ray, and gives a general account of the work of establishing the station; of a journey made by him during the winter toward the north-east, where a river was discovered which was named Meade River; of the arrival of vessels in the spring, the loss of the whaler North Star, and other matters. Little is said of the scientific work of the station, for the reason, frankly stated by the author of the report, of his entire inexperience in such matters, his duties being solely of an executive nature. The extraordinary statement which follows appears in the last paragraph of the report, and is, we have reason to believe, based upon an entire misconception, the 'hut' spoken of having nothing to do with the magnetic observations. "Lieut. Powell brought but one magnetic hut, and it is designed for pendulum observations. I shall put it up, and use it for the new magnetic instruments; but I cannot be responsible for the results, as it is nailed with iron nails throughout." If the above were permitted to stand unexplained or uncorrected, every person possessed of any knowledge of magnetics, who might read this report, could not fail to experience the liveliest apprehensions as to the results of such proceedings on the quality of the observations. We believe, however, that it is due to the extreme haste in which the report was necessarily prepared, and that the statement, as it is, results from a transposition or accidental misuse of terms, such as Mr. Richard Grant White has taught us to call 'heterophemy.' The pamphlet is illustrated with a track chart of the Neptune in Baffin's Bay in 1882, and appears as 'Signal-service notes, no. v.' In the endeavor of the chief signal-officer thus to preserve in permanent form scientific observations apart from their stated work, which may be made by members of his corps, he will have the hearty sympathy of the scientific public.

—The annual meeting of the members of the Archaeological institute of America was held in Boston on the 19th ult., Prof. C. E. Norton, the president, in the chair.

The fourth annual report of the executive committee showed, that, since January, Mr. Bandelier has prosecuted his researches in New Mexico, steadily increasing the sum of knowledge concerning the number, the distribution, and the local peculiarities of the ancient Pueblos, and gradually accumulating the information upon which conclusions with respect to the mutual relations and the migrations of the various branches of the native stock, as well as to the limits of their civilization, may be safely based. In a letter dated San Juan, Arizona, April 9, Mr. Bandelier sketches the route which he proposes to follow, in order to trace the two streams into which he believes the main current of immigration to have been divided. First he will go, *viâ* Georgetown, to Chihuahua and Casas Grandes, returning to Tucson. The second route will be southward from Tucson, through Sonora, Sinoloa, etc., to the City of Mexico. From the latter place he will follow the route of Cortés to Vera Cruz, and along the coast to Monterey. In this way Mr. Bandelier will have studied the whole of Mexico north of the 19th parallel. Should Mr. Bandelier be able to accomplish this proposed journey during the present year, one of the most important objects of the institute in the investigations intrusted to him will have been attained. A general survey of the Pueblo settlements, from their northern limit as far as the City of Mexico, will have been made by a competent observer, and many points hitherto in doubt, not only in regard to the Indians, but also concerning the early Spanish discoveries and settlement of the country, will have been determined.

Allusion was made to the celebration of the 333d anniversary of the settlement of Santa Fé, to be held in that place in July; and it was stated that a second edition of Mr. Bandelier's report upon Pécos, which was issued by the institute in 1881, had been prepared to meet a demand which had already come from that section of the country. Unfortunately, Mr. Bandelier's report upon the work done by him in Mexico in 1881 still remains unprinted, though about one-half is in type, owing to a lack of funds. Special contributions are solicited for this purpose. The report contains valuable information in regard to the great pyramid of Cholula, and the decorated houses of Mitla.

Work in Assos was stopped during January, but was resumed later, and the explorations pushed forward with energy in order to accomplish as much as possible before the expiration of the firman at the end of May. At that time nothing will remain to be done but to close the works, and divide the objects found with the Turks. Steps have been taken to obtain from the Turkish government the right to all

of the temple sculptures; and the Boston Museum of fine arts has appropriated two thousand dollars towards the purchase and transportation of antiquities, with the understanding that they shall become the property of the museum.

The different departments of the Assos work will be ably worked up by the several gentlemen in charge. The study and preparation of the inscriptions have been placed in charge of Dr. Sterrett, who has been connected during the past year with the school of classical studies which was established at Athens by the institute. The geology of the Troad will also be fully treated; and a large number of photographs of the site and the excavations, as well as of the objects found, has been made.

Mr. Clarke, in a letter dated April 4, gives an interesting account of recent finds, in the way of figurini (thirteen were found in one sarcophagus) glass, pottery, small bronzes, coins, etc. Besides this, excavations have been continued at the Agora, the west end of the Stoa, and on the fortifications. Moreover, Mr. Clarke has finished his second series of measurements of the temple, made with a heavy steel tape, which will be tested by some public standard to insure perfect accuracy in what will be one of the most important results of the expedition.

The second annual report of the committee of the American school of classical studies at Athens was presented as a part of the fourth annual report. From this it appears that the school has been successfully established, and carried through the first year of its existence, under the able management of Professor Goodwin. There have been seven regular members who have pursued definite subjects of investigations, the results of which will be embodied in theses which may be published in the bulletins of the school.

On Wednesday evenings, meetings have been held in the library, at which papers have been presented by the director or one of the members, and afterwards discussed; on Fridays, meetings were held for the study of Aeschylus and Thucydides; and on Saturdays, excursions were made to places of historic interest within easy reach of Athens.

During the year five colleges have joined the supporters of the school, the list of which now numbers fourteen; while several institutions which have been invited to join have not yet returned a definite answer. Next year Professor Packard of Yale will go out to take charge of the school, under the arrangement by which the supporting colleges send each year, in turn, a professor. The desirability of having a permanent official connected with the school is pointed out, and a strong appeal made for the creation of a special fund, which shall enable the committee to appoint such an officer.

After the reading of the report, a spirited and interesting account was given by Mr. Louis H. Aymé, U. S. consul at Merida, Yucatan, of his investigations in Central America, and of his plans for future work.

The most important business transacted at the meeting was the appointment of a special committee of consultation, to consider what steps could be taken to create and maintain an interest in the work of the institute in New York. They will report to the executive committee with a view to the establishment of a permanent committee to take part in the management of the institute.

The necessity of making constant appeals to the public for funds to carry on the work of the institute has led the executive committee to the resolve not to undertake any new work for the present, unless the money needed should be voluntarily contributed. The work already begun will be finished during the year; and for this purpose at least four thousand dollars above the amount to be counted upon from the annual fees will be needed.

The election of officers of the institute for the coming year resulted in the choice of the old board, with the exception of Mr. W. R. Ware, whose resignation was accepted, and for whom Mr. Stephen Salisbury, jun., of Worcester, was substituted.

— The annual meeting of the Society of arts of the Massachusetts institute of technology was held at the institute May 10. Mr. George F. Swain was unanimously elected secretary of the society for the year beginning Oct. 1, 1883. The following-named gentlemen were elected as members of the executive committee for the ensuing year: Mr. Jacob A. Dresser, Hon. F. W. Lincoln, Mr. Howard A. Carson, Mr. Waldo O. Ross, and Mr. C. J. H. Woodbury. Professor William H. Niles made a report of the work of the permanent meteorological committee of the society since its appointment about a year ago. The committee was formed at the request of the chief signal-officer of the United States to co-operate with the signal-service as far as possible in a general way, and especially to become acquainted with the workings and requirements of the service at the Boston station with the view to suggesting directions for increasing, if possible, its value and efficiency. The committee has found in Sergeant Cole a thoroughly competent head to this station. By recommendations to the chief signal-officer, the committee has been able to effect a material gain in the way of increased reports received at Boston, in the use of more powerful signal-lights for warnings at night, and in some other particulars. The committee has taken under consideration certain other proposed changes relating to the utility of the station in the city, and of the associated display-stations. Professor Niles deplored the present unfortunate impairment of the work of the signal-service through the failure of Congress to make the necessary appropriations. The number of morning reports received

at Boston has been cut down from seventy-seven to five, none of which are from stations west of New England. All the display-stations of the New-England coast have been closed, with the exception of one kept open by the Boston board of trade. The weather synopses have been discontinued, printing and telegraphing reduced, and salaries cut down. All the West-India stations have been closed; and thus, with the cyclone season upon us, we are without warnings which the country is abundantly able to provide. The report of the committee was accepted, and its members were requested to serve for another year.

Mr. J. C. Hoadley then gave an address on driven wells, explaining their action, comparing it with that of dug wells, and giving the results of his experimental investigations of the subject.

A vote of thanks was extended to the retiring secretary, Prof. S. W. Holman, and to Mr. Hoadley.

— At the meeting of the Philosophical society of Washington, May 19, Dr. Robert Fletcher presented a review of Recent experiments on venom poison, discussing especially the supposed antidote discovered in Brazil, and the separation of rattlesnake poison by Dr. Mitchell into three parts, two of which have definite and distinct toxic properties.

Mr. Farquhar, whose experiments in binary arithmetic have already been noticed in SCIENCE, gave an account of some additional experiments, confirming the conclusion that a binary notation may successfully compete with a denary for rapidity of arithmetic work, and showing that the ratio between the horizontal and vertical dimensions of the binary character has a material influence on facility of computation.

— A large company assembled in the rooms of the Cincinnati society of natural history on Wednesday evening, May 23, to celebrate the 176th anniversary of the birthday of Carl von Linné. The lecture-room was beautifully decorated with ferns and natural flowers, and mounted specimens of plants adorned the walls. The name of Linné in evergreens was placed above a beautiful miniature portrait of the great botanist, the frame of which was wreathed in smilax, while below was an autograph letter lent by a local collector. Three papers were read, on the life, the botanical and the zoölogical labors of Linné, by Mr. Davis L. James, Prof. A. P. Morgan, and Prof. Joseph F. James. After the reading, the audience was invited to the council-room, where an interesting microscopical *soirée* was held.

RECENT BOOKS AND PAMPHLETS.

Bate, J. Influence of the mind on mind. London, *Woolmer*, 1883. 696 p. 8°.

Bernhardi, Fritz. Das norddeutsche diluvium eine gletscherbildung, ein versuch, die richtigkeit der Forel'schen theorie aus der beschaffenheit und gestaltung unseres heimischen bodens zu erweisen. Züllichan, *Augustin*, 1883. 3+48 p. 8°.

Brown, T. T. Photometry and gas analyses. London, 1883. 8°.

Brown, Walter Lee. Manual of assaying gold, silver, copper, and lead ores. Chicago, *Jansen, McClurg, & Co.*, 1883. 318 p., illustr. 12°.

Burgess, J. Archeological survey of western India. iv., v.: Report on the Buddhist and Elura cave-temples. London, *Trübner*, 1883. f°.

Colquhoun, A. R. Across Chrysê: being a narrative of a journey of exploration through the South China borderlands, from Canton to Mandalay. London, *Low*, 1883. 2 vols., maps, 300 illustr. 8°.

Cramer, C. Ueber das bewegungsvermögen der pflanzen. Basel, *Schwabe*, 1883. 8°.

Fenton, H. J. H. Notes on qualitative analysis, concise and explanatory. London, *Cambridge Warehouse*, 1883. 128 p. 4°.

Fergusson, James. The Parthenon: an essay on the mode by which light was introduced into Greek and Roman temples. London, *Murray*, 1883. 8+135 p., 5 pl., illustr. 4°.

Galton, Francis. Inquiries into human faculty and its development. N.Y., *Macmillan*, 1883. 12+380 p., 6 pl. 8°.

Griffin, La Roy F. Lecture notes in chemistry: a syllabus of chemistry, compiled principally from the manuals of Miller and of Roscoe and Schoelemmer. Philadelphia, *Sower, Potts, & Co.*, [1883]. 6+99 p. 12°.

Houghton farm. Series III. Experiment department. No. 1-2. N.Y., *Dodge pr.*, 1883. 45 p., 4 pl. 8°.

Iowa state academy of sciences. Constitution and by-laws [including summary of transactions]. Des Moines, *Brewster pr.*, 1882. 24 p. 12°.

Joly, N. Man before metals. N.Y., *Appleton*, 1883. 8+365 p. 12°.

Kayser, H. Lehrbuch der spectral-analyse. Berlin, *Springer*, 1883. 11+358 p., illustr. 8°.

Keller, C. Das thierleben in grossen meerestiefen. Basel, *Schwabe*, 1883. 8°.

Kraepelin, Karl. Ueber die geruchsorgane der gliederthiere. Eine historisch-krit. studie. Hamburg, *Nolte*, 1883. 48 p., 3 pl. 4°.

Macloskie, G. Elementary botany, with student's guide to the examination and description of plants. N.Y., *Holt*, 1883. 8+373 p., illustr. 12°.

Müller, F. Max. India: what can it teach us? A course of lectures delivered before the University of Cambridge. London, *Longmans*, 1883. 11+402 p. 8°.

National academy of sciences. Constitution and membership, April 21, 1883. Washington, *Academy*, 1883. 24 p. 8°.

Ontario — Entomological society. Report for the year 1882. Toronto, *Robinson pr.*, 1883. 83 p. 8°.

Page, T. Physical geography of mountains and rivers; together with a general explanation of geographical terms. London, *Moffatt*, 1883. 80 p. 12°.

Palestine exploration fund. The survey of western Palestine. Memoirs of the topography, orography, hydrography, and archeology. Vol. 3. Sheets 17-26. London, *Fund*, 1883. 7+450 p. 4°.

Palmer, A. S. Folk-etymology: a dictionary of verbal corruptions or words perverted in form or meaning by false derivation or mistaken analogy. N.Y., *Holt*, 1883. 22+664 p. 8°.

Perrot, G., and **Chipiez**, C. A history of art in ancient Egypt. Translated and edited by Walter Armstrong. 2 vols. London, *Chapman & Hall*, 1883. 64+444, 16+426 p., illustr. l. 8°.

Pocket logarithms to four places of decimals, including logarithms of numbers and logarithmic sines and tangents to single minutes; to which is added a table of natural sines, tangents, and co-tangents. N.Y., *Van Nostrand*, 1883. 139 p. 16°.

Pressensé, E. de. A study of origins; or, the problems of knowledge, of being, and of duty. Translated by Annie H. Holmden. London, *Hodder & Stoughton*, 1883. 36+515 p. 16°.

Saunders, William. Insects injurious to fruits. Illustrated with 440 cuts. Philadelphia, *Lippincott*, 1883. 436 p. 8°.

Schleiden, M. J. The sciences among the Jews before and during the middle ages. From the 4th German ed. Baltimore, *Binswanger & Co.*, 1883. 64 p.

Stearns, Winfrid A. New England bird-life: being a manual of New England ornithology. Revised and edited from the manuscript of Winfrid A. Stearns, by Elliott Coues. Part 2: Non-oscine Passeres, birds of prey, game and water birds. Boston, *Lee & Shepard*, 1883. 409 p. 12°.

Wagner, M. Untersuchungen über die resorption der calcium-salze und über die abstammung der freien salzsäure im magensaft, nebst einigen erörterungen über die pathogenese der rachitis. Zurich, *Füssli*, 1883. 8°.